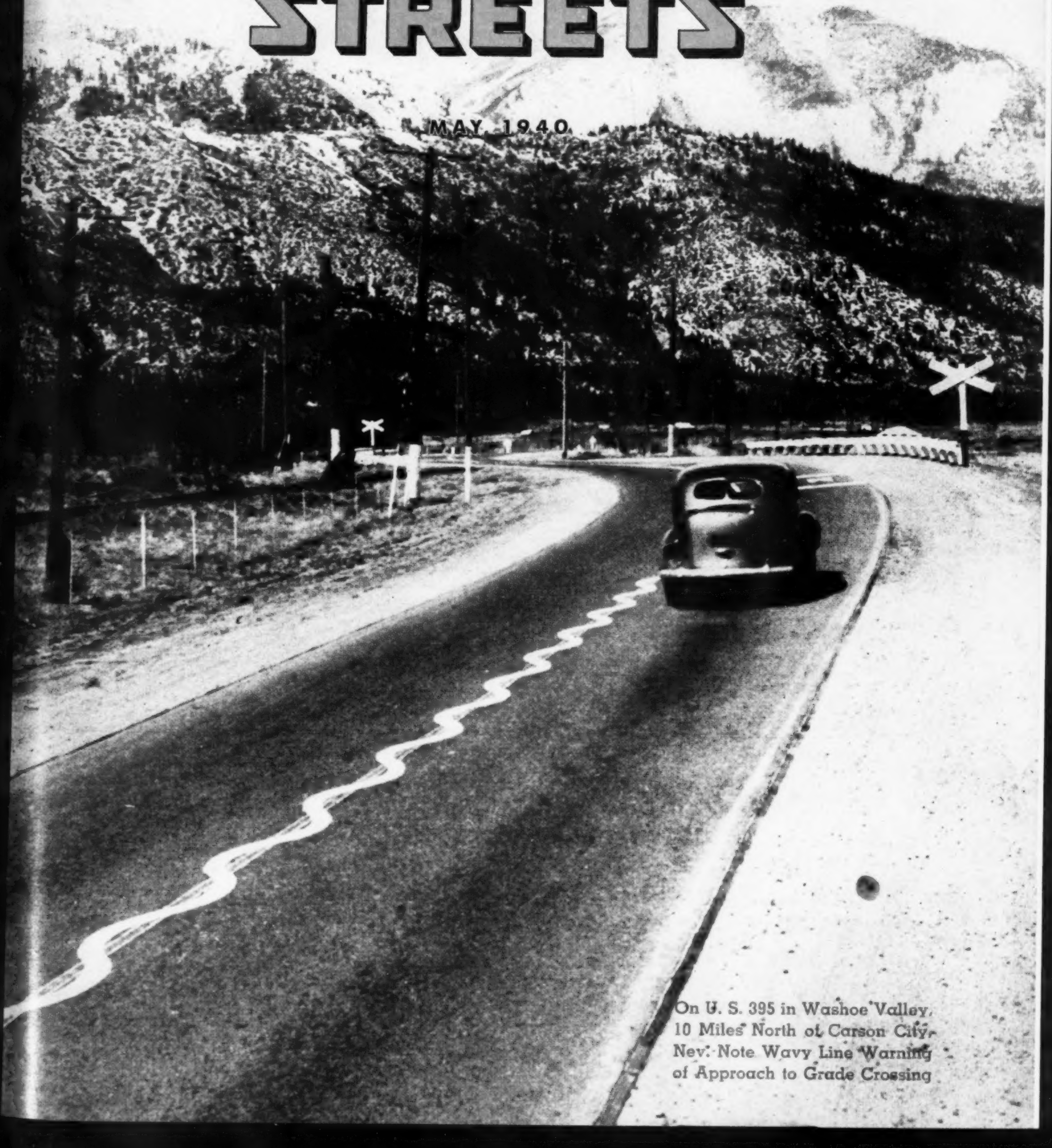
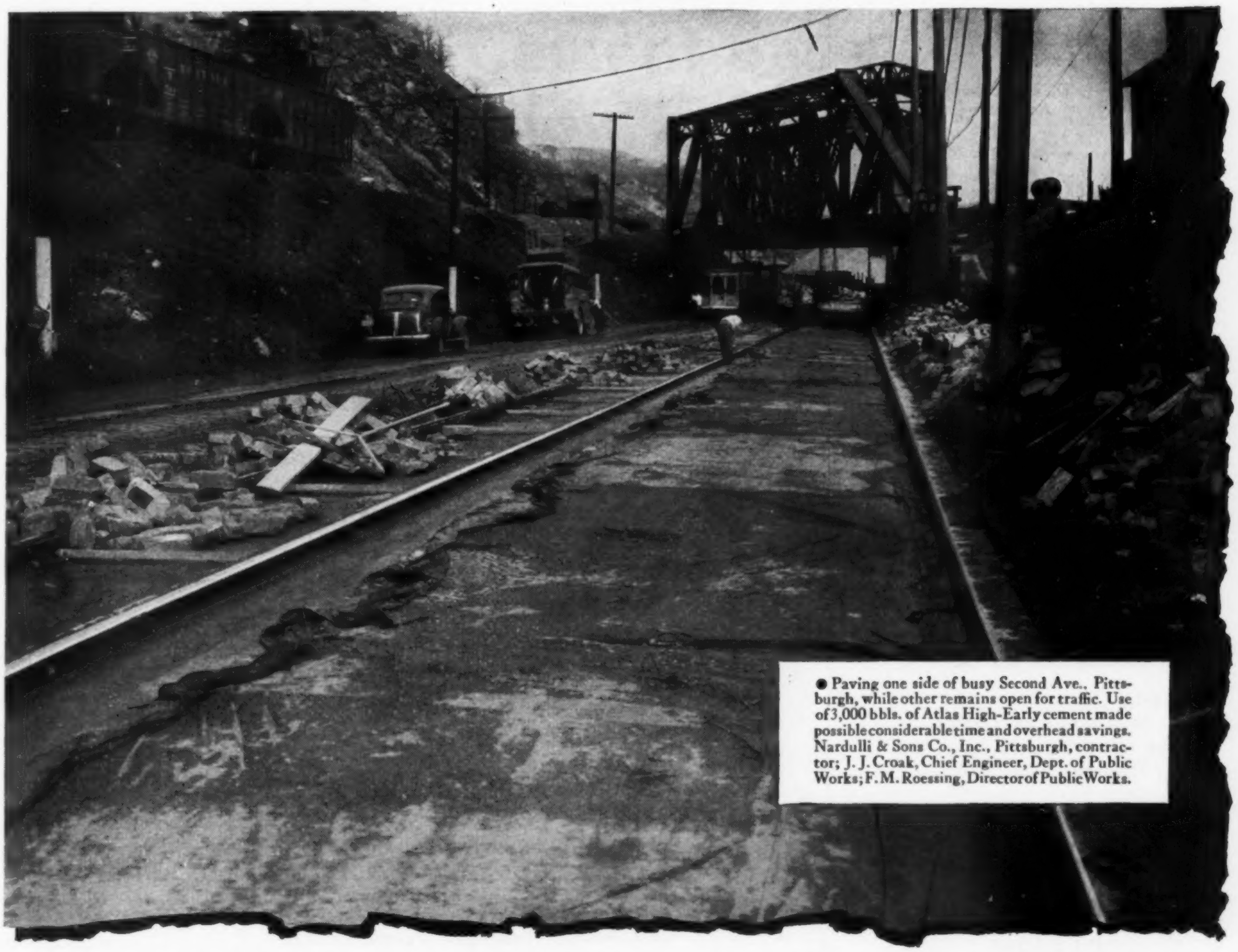
ROADS AND STREETS

MAY 1940



On U. S. 395 in Washoe Valley, 10 Miles North of Carson City, Nev. Note Wavy Line Warning of Approach to Grade Crossing

REWARDED FOR SPEEDING on a busy road!



● Paving one side of busy Second Ave., Pittsburgh, while other remains open for traffic. Use of 3,000 bbls. of Atlas High-Early cement made possible considerable time and overhead savings. Nardulli & Sons Co., Inc., Pittsburgh, contractor; J. J. Croak, Chief Engineer, Dept. of Public Works; F. M. Roessing, Director of Public Works.

THE extremely heavy automobile and street-car traffic on Pittsburgh's Second Avenue forced complete repaving. Problem was to get this job done in the shortest possible time, with the least possible traffic tie-up.

The contractor knew he could make a large saving in repaving time by getting rid of long protection and curing delays. So he used a cement that gains strength rapidly—Atlas High-Early cement! First the base for one side of the road was concreted. Then—within a minimum amount of time—the contractor switched traffic and started concreting the other side.

The rewards? Each strip of road was ready for traffic much earlier than would otherwise have been possible. The job was done in winter weather, and so several days' protection and curing time was saved. Added up, these items made a substantial time and overhead saving!

Speed up your road, bridge and other construction by using Atlas High-Early cement. Although this cement costs slightly more, the savings in time and overhead often more than pay for the extra cost. For more facts, write Universal Atlas Cement Co. (United States Steel Corp. Subsidiary), Chrysler Building, New York City.

RS-H-15

ATLAS HIGH-EARLY CEMENT

A UNIVERSAL ATLAS PRODUCT

ROADS and STREETS

With which have been merged GOOD ROADS and ENGINEERING & CONTRACTING

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CCA

THIS MAGAZINE IS DEVOTED TO
Design, Construction and Maintenance of Highways, Streets, Bridges and Grade Separations

H. P. GILLETTE, Editor | V. J. BROWN, Publishing Director | E. S. GILLETTE, Publisher

Vol. 83 MAY, 1940 No. 5

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ROADS and STREETS

Vol. 83, No. 5 May, 1940

A GILLETTE PUBLICATION
ESTABLISHED 1906

Plant-Mix Soil-Cement Base Course Over Blow Sand

Texas Tries

Clay Blanket Laid Over Subgrade and Shoulders Prior to Placing Base Course

By V. J. BROWN
Publishing Director
ROADS AND STREETS

PLANT-MIX for soil-cement mixtures provides more accurate control of the ingredients than road-mix methods.

In order to have first hand experience with this type of construction, the Texas Highway Department is building a section of Highway 96 from Sarita to the Willacy County line. The 8-6-8 in. soil-cement base will be covered with a standard Texas double asphalt surface treatment. The project is 42.729 miles long. The first section, 8.036 miles is under construction by the Briggs-Darby Construction Company and the balance, or 34.693 miles is under contract to Heldenfels Brothers. The latter is assembling and erecting his plant as this is written.

The construction procedure on these projects is different from any the writer has seen in this country. Tests devised by District Engineer Puckett are used to evaluate the cement content, in addition to those usually recommended by the Portland Cement Association.

Design

For the whole distance the road has been graded and drained. An interesting feature is that the road is built in blow sand for its full length. Dunes are constantly moving and the railroad found it necessary for a half mile stretch about 1500 ft. wide between the railroad and the highway to lay a clay brush blanket over the whole area. Local vegetation has started to help hold the blanket. Naturally, the roadbed for the highway had to be protected against wind erosion also. Furthermore, the subgrade, being pure blow sand, had to be covered in order to be able to move hauling and construction equipment over it. So the cross-sectional design included a clay blanket 3 in. thick to be placed over the roadbed and a variable thickness out over the shoulders as shown by Fig. 1. The cross-section of the base course only is shown by Fig. 2. On top of this a double asphalt surface treat-

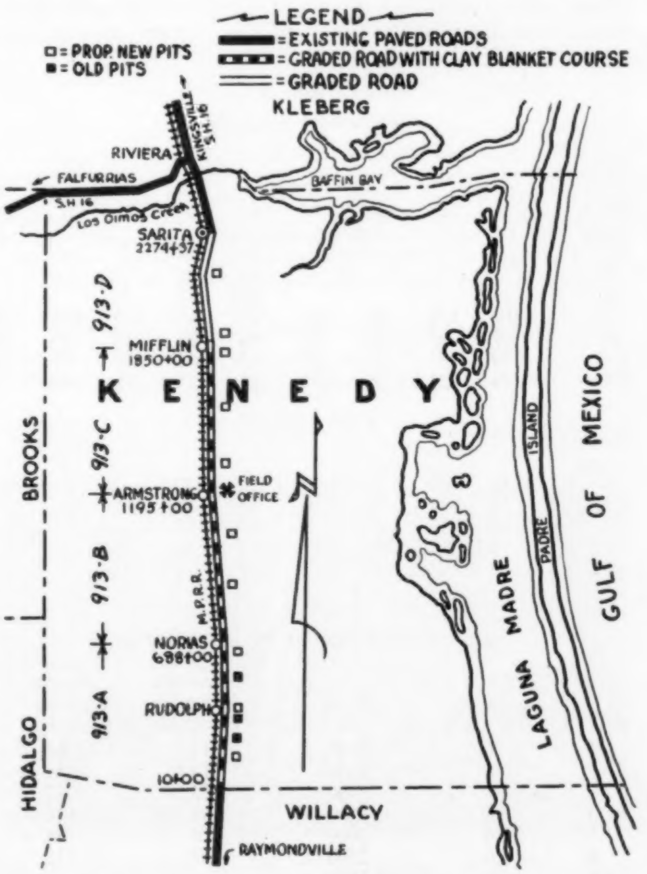


Fig. 1.—Line and Location of Soil-Cement Base Job. Project Numbers Along Left

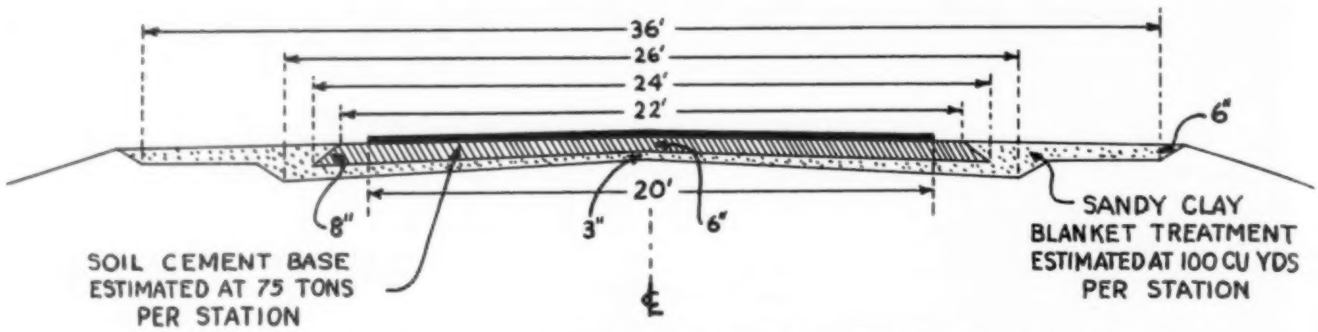


Fig. 2.—Typical Cross-Section of Soil-Cement Road Through Dune-Sand in Kennedy County, Texas

ment using 135 penetration asphalt cement, called oil asphalt in Texas, is placed for a 20 foot width.

Design of Mixture.—Samples from the nine selected borrow pits were run through for mechanical analysis and the results indicated by Table I were obtained. On pit No. 8 the material flocculated and therefore hydrometer analysis could not be made with the

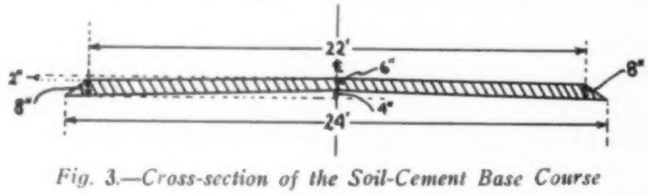


Fig. 3.—Cross-section of the Soil-Cement Base Course

equipment used in the field. Then standard freezing-thawing and wetting-drying tests were run on samples with mixtures containing 6, 7, 8, and 10 per cent cement content. In addition to the standard tests, the modified bearing value test and a shear test was made on the specimens. These with the optimum water content and maximum density of the mixture furnished the bases for decision

TABLE I

Mechanical Analysis

F A P.-A 13—A, B, C, D

Sieve Sizes	Pit Numbers 1	2	3	4	5	6	7	8	10
	Percent Passing								
¼"					99	99			
10					98	98			
20					98†	97			
40	100	100	100	100	97	96	100	100	100
60	97	98	96	98	96	92	98	96	98
100	50	55	50	58	63	46	62	73	65
200	20	21.5	25	24	31	21	10	60	23
	Fine Material								
Grain Sizes									
.05	18	20	24	19	26	20.5	8		20
.02	16	17	21	16	18	18	5		17
.01	15	15	20	15	17	17	4	-Floc-	16
.005	14.5	13.5	20	14	13	16	3.5		15
.001	14	13	19	14	11	11	2		12.5

TABLE II

Mixture Test Results by Pit Numbers

Pit No.	Cement Per Cent	Shear lb.	Optimum Moisture Per Cent	Maximum Density lbs. per Cu. Ft.
1	6	2600	14	115
2	6	2600	13.5	116
3	6	2400	13	115
4	6	3100	13	116.5
5	6	3000	14	115
6	6	2300	12	112
7	6	1600	—	—
8	6	2175	14	108
10	6	2175	13.5	113

Fig. 4.—Typical Sand Dune Approaching Right-of-Way Fence

of the cement content to use. The design was then based upon a 6 per cent cement content with results shown by Table II.

This is the first time the shear test has been used in the state for soil-cement mix design. It consists of compacting the mixture in a modified Proctor mold 2 in. in height. It is allowed to cure for 7 days in a moist closet. Then it is punch-sheared by hydraulic ram while still in the mold with a round punch having a cross-sectional area of 1 sq. in. The Proctor mold, which is 4 in. in diameter, is placed upon a base having a circular opening of 3 in. in diameter. The shear test is considered favorably when designing the mix. For cement contents of 10 per cent, the shear values ranged from 1¼ to 2 times the values shown in Table II.

Fig. 5.—Clay Blanket Placed by Railroad Company for Wind Erosion Control. Entire Distance, about 1500 Ft. Wide, Between Tracks and Highway Was Blanketed for a Distance of One-Half Mile. Live Oak Brush and Zacahuiche Grass Planted to Hold Blanket, Cost About $150 per Acre

Construction Procedure

From the nine selected pits the sandy clay blanket is hauled, starting at the pits and working each direction. Thus, the trucks can haul over a material which prevents them from getting bogged in the underlying sand. The sub-grade is shaped by a maintainer, and final finish

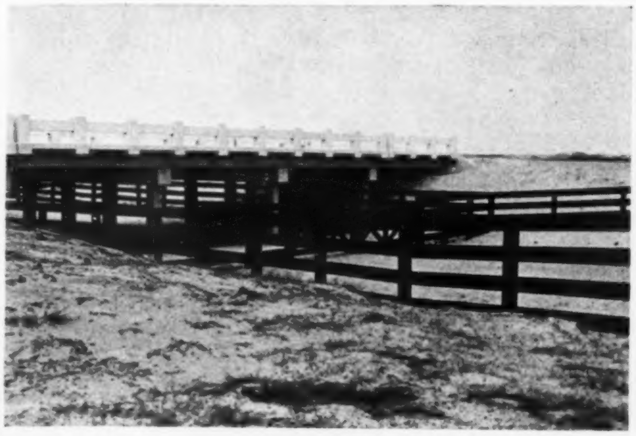


Fig. 6.—Entire Road Is Through Ranch County. State Provided Five 100 Ft. Cattle Passes as Shown as Well as Fencing for Approximately 40 Miles

attained by hand, before the clay blanket is placed. A bulldozer was used to spread the sand-clay. Compaction was accomplished by the equipment working over it, trucks and tractors. Just before the soil-cement mixture was to be placed, the blanket was wetted and a motor grader used to bring it to the proper grade and width. A survey party gave line and grade stakes for this operation. After shaping, it was again sprinkled and rolled with a rubber tired roller. This unit is one in which each wheel acts independently and because the front row of tires is offset with the back row, the whole area is covered. Each wheel is individually axled and actuated by an hydraulic ram. Thus all soft places are compacted. The same roller was used for the finish rolling of the base mixture. It is shown in Fig. 7.

Fig. 7.—Pneumatic Tired Roller Used for Compacting Clay Blanket and for Finish Rolling of Base Mixture. Each Wheel Is Individually Axled and Hydraulic Ram Apply Pressure Individually to Each Wheel

Preparing the Mixture.—In the pit a dragline, operating on top, loads trucks which haul the raw soil to a grizzly screen with bars spaced 6 in. apart. As stated, the ground surface is only a few feet above sea level, so trucks in the pit would get bogged if a shovel was used. Workmen break up lumps on the grizzly, and the load drops down onto a hopper plate feeder which pushes the material onto a belt conveyor. Figures 8, 9,

Fig. 8.—Excavating Selected Pit Material

10 and 11 show these operations, and the carrying of the soil to the pug mill. From the first conveyor the soil passes through a rotary screen with ½ in. circular openings. The passed material drops into a bin which feeds the second conveyor while the oversize passes through

Fig. 9.—General View of Mixing Plant. Dumping on Grizzly in Foreground. At End of First Conveyor Soil Passes Through Rotary Screen and Oversize Through a Clay Disintegrator From Which Fallings Are Dumped Onto Second Conveyor. Second Conveyor Carries Soil to Weigh Hopper. Hopper Dumps Into 4000 lb. Twin Pug Mill. Gasoline Engine Provides Power. Steam Boiler Actuates Pug Mill Door and Furnishes Steam for Water Pumps. This Whole Plant, Like Topsy, "Just Growed"

a clay disintegrator and thence onto the second conveyor. The disintegrator is shown in Fig. 12.

Batching.—Soil from the second conveyor spills

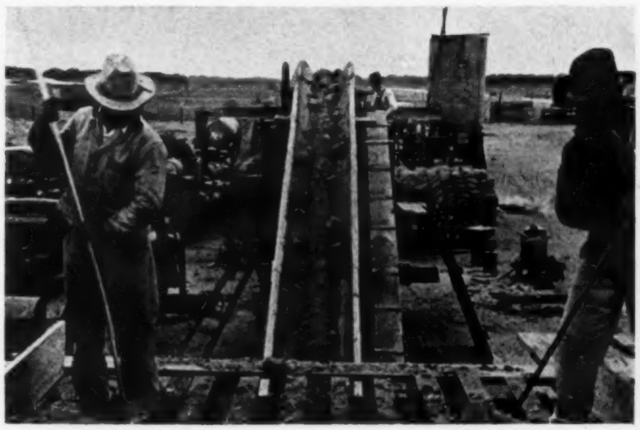


Fig. 10.—Slash Bars Punching Clods Through Grizzly. Note Clay Clods on Conveyor. Note Sacked Cement by Pug Mill and Water Storage Tank

Fig. 11.—Belt Conveyor Transporting Screened and Crushed Material to Weigh Hopper. Conveyor Is Stopped While Dumping Batches Into Pug Mill

into a weigh hopper. The conveyor must be halted between weigh fillings. The soil is dumped into a twin shaft pug mill of 4000 lb. capacity. However, the size of each batch is only 2700 lb., including the cement which

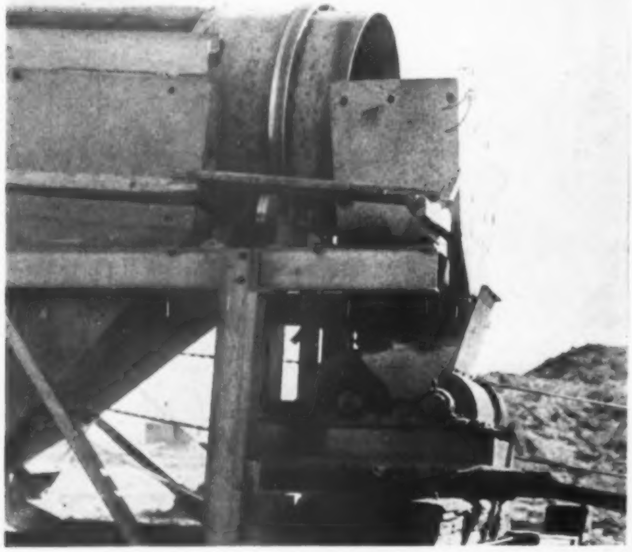


Fig. 12.—Clay Disintegrator Breaks Clods to ½ in. Maximum Size. Its Capacity Is Much Greater Than the Amount of Oversize Materials Which It Is Handling

Fig. 13.—Well Water Pumped by Air From Well Into Storage Tank at Left of Air Compressor in Background. Pump in Foreground Used for Loading Water Tank Trucks

is dumped into the mix from a small auxilliary hopper suspended from the side of pug-mill. Water is measured in a calibrated tank and only that amount introduced to bring the mixture to optimum moisture content for compaction plus an estimated allowance for evaporation. Inspectors make regular soil moisture determinations periodically throughout the day and adjust the water gauge as required. Water is obtained from a drilled well and pumped to a tank near the well, as shown in tank rapidly enough so a steam pump with large outlet fills it. From the measuring tank the water is introduced

Fig. 14.—Loading a Truck From the Pug Mill

in the pug mill through a series of spray jets. This re-Fig. 13, from which it is pumped into tank trucks. The trucks are emptied by steam pumps, into a storage tank at the plant. Gravity flow does not load the calibrated quires speed and pressure so another steam pump rapidly empties the measuring tank through the jets.

Pug Mill.—It was found that several blades had to be removed from the mill as operated for bituminous

Fig. 15.—Field Laboratory and Truck Scales. Tent Houses Modified Bearing Value Testing Equipment and Capillary Testing Tank

mixtures. Also, a 45 second mixing cycle was found to be best. The high shaft speed for bituminous mixtures was found unsatisfactory for soils. Greater output and better mixtures are obtained by reducing shaft speeds to about 65 r.p.m. A steam operated quick-opening gate in the bottom of the pug mill drops the mixture into trucks. From 4 to 6 tons are hauled away and pass over a platform scales where the load is weighed. The trucks are weighed-in because the contractor is paid for the base mixture on a tonnage basis.

Fig. 16—Trucks on Prepared Subgrade Dumping Into Machines Used for Spreading

Spreading and Finishing Base Course.—When the trucks arrive on the roadbed, they are backed into each of two revamped Adnun black top pavers. The pavers spread the mixture and are kept as nearly abreast as possible at all times. The broad wheels under the pavers cause undesirable compaction, so scarifying teeth have been added to break up the ineffectively compacted strips. The fluffy mixture is spread about double the required final thickness.

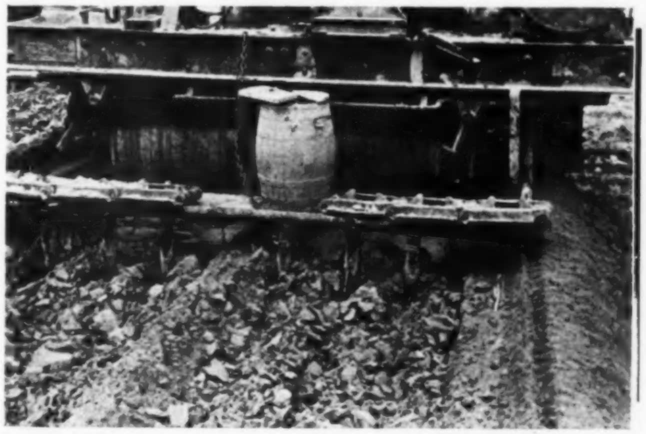


Fig. 17.—Closeup of Scarifier Teeth Attached to Machines Used for Spreading. They Break Up Partially Compacted Material. Note Size of Clods Left

Fig. 18.—Front-end Mounted Sheepsfoot Roller Operates Closely Behind the Spreaders

Immediately behind the spreaders a front end mounted sheepsfoot roller compacts the mixture. Mounting the sheepsfoot roller on the front-end of the tractor allows compaction to proceed without the unit having to leave the roadbed, without having to turn around, or without having to operate on he finished base. The writer has never seen this done before.

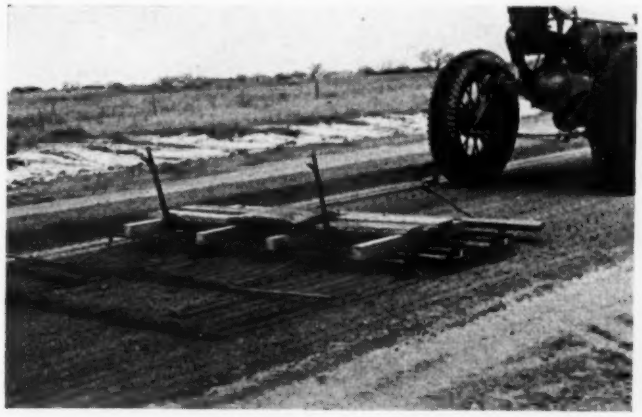


Fig. 20.—Spike tooth Harrow and Light Drag Used to Eliminate Cleavage Planes Near Surface of Base. This Harrow Operated Continuously After Completion of Sheepsfoot Rolling and During the Blading, before Pneumatic Rolling

When the compacting roller neared the top the roadbed was shaped with a motor grader. A spike-toothed harrow followed for breaking up the near surface compaction planes formed by shaping operation. Moisture lost by evaporation in the surface is then restored by use of a tank truck equipped with a pressure pump and spraybars which applies the water in a fine spray. The pneumatic roller then finished the compaction. A final

Fig. 21.—Applying the Curing Coat of RC-2 Asphalt. It Also Serves as the P. ime Coat

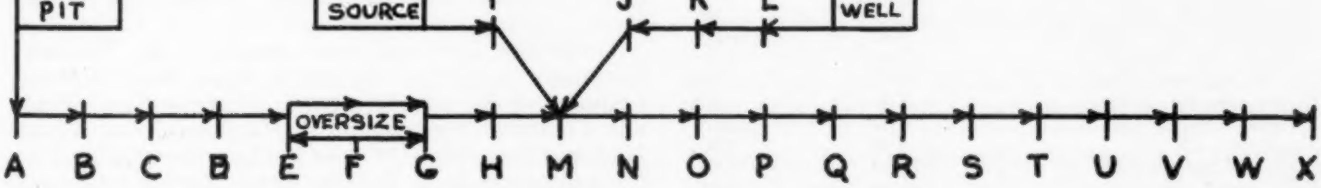


Fig. 19.—Flow Diagram of Sequence of Operations

smoothing by the motor grader prepared the surface to receive wet cotton mats for curing. The flow diagram, Fig. 19, shows the sequence of operations.

After 24 hours the cotton mats are removed and 0.3 gal. of RC-2 asphalt applied per square yard as a cure and prime coat. Considerable spalling occurred in a section completed shortly after the work started. This was found to have been occasioned by compaction planes near the surface which were formed by the maintainer in shaping the base before pneumatic rolling. This trouble has been eliminated by use of a drag harrow following the shaping operation.

Surface Course

After the base course has cured for 28 days a double asphalt surface treatment is applied. This is a proved surfacing and is covered by the state specifications. Following are specifications for the aggregates and the asphalt:

Application	Gal. per Square Yd. Min.	Max.	Aggregate Cu. yards to Sq. Yds. Min.	Max.
First	0.2	0.3	1:100	1:75
Second	0.3	0.4	1:200	1:150

Aggregate No. 1

	Per cent
Retained on ⅝ in. screen	0
" " ½ " "	0-10
" " ¼ " "	70-100
" " No. 10 "	95-100

Aggregate No. 2

	Per cent
Retained on ⅜ in. screen	0
" " ¼ " "	2-20
" " No. 10 "	70-100
" " No. 20 "	95-100

In Texas an asphalt cement is called an "oil asphalt." For this job OA 135 was used. It is a Texas designation with the following characteristics:

Limits	Min.	Max.
Penetration, 77 deg./100 gr./5 sec.	120	150
Ductility, 77 deg./cm.	100	....
Flash Point, deg. F.	450	....
Melting Point, deg. F.	104	140
Loss, 325 deg. F./5 hrs./%	....	0.75
Penetration of Residue, 77 deg. F.	70	....
Solubility, CCl 4	99.5	....

The material must not be cracked.

The asphalt is heated between 325 and 375 degrees F. and applied as shown above. Chips or pea gravel, referred to as "Aggregate" is spread immediately behind the distributor.

Contract Prices

Following are the prices bid for the two jobs:

Item	913 D-1	913 A-2 B-2, C-2
Clearing and grubbing, Acre	$ 5.00	$ 5.00
Common road excavation, CY	0.15	0.12
Sprinkling, M gal	1.25	1.00
Sheepsfoot rolling, Hr	3.50	2.70
Pneumatic rolling, Hr	2.50	2.20
Roadbed treatment, CY	0.15	0.17
Add. ¼ mi. haul, CY	0.0225	0.025
Disc harrowing, Hr	3.00	?*
Soil-cement base course, Ton	0.85	0.67
Portland cement, Bbl	2.85	2.85
Add ¼ mi. haul. Ton	0.025	0.018
Prime coat, RC-2, Gal	0.09	.105
Asphalt—OA135, Gal.	0.09	0.08
Aggregate, CY	4.00	3.90
Class A Concrete, CY	20.00	15.00
Reinf. steel, lb	0.06	0.05
Stripping pits, CY	.08	.08

Personnel

The first section to start work, 913 D-1, 8.036 miles long, is being done by the Briggs-Darby Construction Company, Inc., Pharr, Texas. The other projects, 34,693 miles long, is under contract to Heldenfels Brothers, Corpus Christi, Texas.

District Engineer J. W. Puckett, Pharr, Texas, is in charge with direct supervision under Resident Engineer W. J. Apperson, Armstrong, Texas.

Heldenfels Brothers, were setting up a plant as this was written. They have made many improvements over the plant now operating. Instead of a rotary screen they will use a vibratory screen. They have installed a double twin shaft pugmill with a redesigned bottom gate which will be operated by air, two V-8 Caterpillar diesel engines will provide primary power. The water gauge will be the same, as will the clay disintegrator. Compressed air will be used to actuate pumps.

WESTERN ASSOCIATION OF STATE HIGHWAY OFFICIALS MEET

The New Mexico State Highway Department was host to the delegates from the twelve states comprising the Western Association of State Highway Officials at their Nineteenth Annual Convention. The convention opened on the morning of April 17 with the registration of delegates and guests.

Delegations from all the member states, namely, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Texas, Utah, Washington, and Wyoming, were present as well as District and Regional Officials of the Public Roads Administration. W. C. Markham, Executive Secretary of the American Association of State Highway Officials also attended. There were 112 official delegates registered for the convention.

The program was officially opened by Honorable John E. Miles, Governor of New Mexico, and Mayor Alfredo Ortiz of Santa Fe, followed by an address by the Honorable Wilburn Cartwright of Oklahoma. The greater portion of the program was carried out as scheduled, although Representative John J. Dempsey of New Mexico and Governor Ayres of Montana were unable to be present. All meetings were well attended with all phases of highway construction, maintenance and financing, as they affect the western states, sharing in the discussions by all delegates and by the various committees.

Delegates and guests were treated to a variety of entertainment, the high light of the events being "La Fiesta" which was held on Friday night, with the greater portion of the celebrants in Spanish and Fiesta costumes.

The Association's next convention will be held either in Montana or Idaho, the definite choice being left in the hands of Mr. McKinnon of Montana and Mr. Flint of Idaho. The date of the next annual convention will be set by the Executive Committee at a later date.

The election of officers was held with B. G. Dwyre, New Mexico State Highway Engineer, elected President; C. F. Seifried, Wyoming Highway Department Office Engineer, elected Vice President; and H. R. Flint, Idaho Highway Director, elected Secretary and Treasurer.

Three new members were named to the Executive Committee as follows: Robert A. Allen, State Highway Engineer of Nevada; Preston G. Peterson, Utah Highway Commissioner; and W. R. Hutchins, Arizona State Highway Engineer. The four hold over members of the Committee are R. L. Bobbitt, Texas Highway Commissioner, Dr. L. I. Hewes, Public Roads Administration,

Delegates Attending the 19th Annual Convention of the Western Association of State Highway Officials. Picture Taken in the Patio of La Fonda Hotel, Santa Fe, New Mexico. The State Highway Department of New Mexico Was Host to the Conventioneers. [Ed.—Since We Cannot Identify About Ten of Those Present, We Omitted the Names of Everyone.]

D. A. McKinnon, Montana Highway Engineer, and Chas. D. Vail, Colorado Highway Engineer.

Resolutions Adopted

Following is the gist of the principle resolutions that were adopted by the Association:

No. 1.—For the past twenty-five years, through cooperation between the State Highway Departments and the Public Roads Administration, there has been constructed in the United States a system of highways which is outstanding in the world.

From the funds allocated, the people of the nation now have a capital investment of at least 75 per cent of such funds which is still paying returns to them.

There is an apparent tendency on the part of other agencies to create a duplicating agency to carry on similar types of work.

Through the cooperation of the State Highway Departments and the Public Roads Administration, basic data have been compiled which now are available to determine comprehensive State Highway programs.

Through the present cooperative arrangement there has been developed in the State Highway Departments and the Public Roads Administration a trained engineering personnel and organization competent to carry on highway building activities.

Therefore, the Western Association of State Highway Officials, representing the highway construction activities of the twelve western states, vigorously opposes any change in the fundamental procedure, organization and methods of allocating funds and designating road systems and mileage.

Further, it is the considered opinion of the association that any Federal funds in the future to be used for highway construction should be expended through the State Highway Departments and the Public Roads Administration and no other Federal Agencies.

No. 2.—In the future, the Western Association of State Highway Officials shall include the States of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Texas, Utah, Washington, and Wyoming, and no further reference to the eleven western states in correspondence or otherwise, will be made.

No. 3.—Under the existing law and regulations, there is unnecessary and definite confusion with respect to the availability of Forest Highway funds.

Therefore the Western Association of State Highway Officials recommends to the consideration of the Congress the separation of Forest Highway funds from other Forest Road funds in making future authorizations or appropriations.

No. 4.—The Federal Government is collecting from the highway users more special taxes than are being returned to the various states and sub-divisions thereof, for the purpose of systematic and coordinated highway construction.

Therefore, they recommend to the consideration of Congress that it make available all of the highway user taxes collected by the Federal Government for such systematic and coordinated highway construction through State Highway Departments and the Public Roads Administration.

No. 5.—There has now been introduced into Congress proposed legislation providing aid to the states from the Federal Government in the acquisition of rights-of-way upon application by the State Highway Departments.

The Western Association of State Highway Officials endorses, in principle, such proposed legislation.

No. 6.—Existing authorization for Federal participation in highway construction expires at the end of the fiscal year of 1941.

Legislation has been introduced continuing such Federal participation.

The Western Association of State Highway Officials urges early and favorable action on such pending legislation.

The amount of authorization for the fiscal years 1942 and 1943 should be not less than the amounts of the 1938 and 1939 authorization.

OBSERVATIONS BY THE WAY

By
A. PUDDLE JUMPER

¶ Picture herewith shows a Marmon-Herrington truck used by Nebraska to maintain State Route 32. Note the snow drifts and how the melting snow created an almost impassable road condition. Maintenance patrolman is digging channel to take water off road. This picture was taken east of Albion, Nebr. The maintenance patrolmen on the 80 miles of gravel road I traveled were doing excellent work. A small win-

drow of gravel along the shoulder of the road was opened at about 200 ft. intervals to allow water to get into the ditch from the road surface.

On this trip I traveled west from Sioux City after a heavy sleet storm and I wish to congratulate the sanding crews who were apparently out on the job by daybreak. Traffic moved fast over the icy pavements. All hills were well sanded. Good work!

• •

¶ That's my piece that Stanley Abel is turning over while Fred See lends a helping hand. Fred and I lent helping m o u t h s mostly. Stanley, you know, is the county supervisor of the Fourth District of Kern County, Calif. He's an energetic pusher when it comes to local affairs; particularly roads. Fred Lee is copartner of Lee and Thatro, equipment distributors of Los Angeles. He looks a great deal

like F. D. Roosevelt. We had an enjoyable evening after looking over a new county road to Mt. Abel.

• •

¶ Now who do you suppose this bewhiskered gentleman can be? Impersonating Dr. I. Q., Datus Proper, that witty secretary of the Texas Good Roads Association will tell you all about the "pemiscus" if you ask him. He's an authority on the char-

acteristics, size, and function of the "pemiscus." His headquarters are in San Antonio, but here he is conducting an quiz on the "pemiscus" at the annual banquet of the Texas A. & M. Highway Short Course.

• •

¶ Kansas certainly took a beating from Ol' Man Winter this year. Many miles of their roads looked like those of North Carolina after the winter of 1935-36 there.

• •

¶ "I'll say A. P. J.'s triangle problem (April issue) is good. I'm a Time Waster fan and should know. * * * To solve, just draw a couple of lines parallel to the base of the larger and through the upper vertices of the smaller then solve. And what have you? I'll say the answer is one-third of one. Hey! Smarty!—*Walter S. Wheeler, City Engineer, P. O. Box 43, Dover, N. H.*

• •

¶ From Trenton, N. J., came the following letter:

Attention: "A Puddle Jumper."

The April issue of ROADS AND STREETS has a geometry problem on page 41.

In my opinion not sufficient information is given to permit of a correct solution of the problem. It is not stated whether the measurements ⅓ and ⅔ are linear units or ratios.

If these fractions represent units of linear measure, then the problem is an impossible construction, since an equilateral triangle having a side equal to 1 cannot also have an area equal to one square unit.

Although it is not stated in the hypothesis, I have assumed that the fractions represent ratios of the segments of the sides. However, I have not yet been able to arrive at any solution.

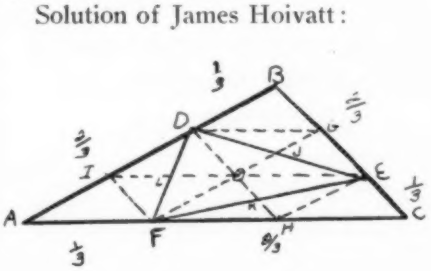
In any event, I am weak and weary from such unaccustomed profound lucubration.

• •

¶ In the April number of ROADS AND STREETS you have a problem in geometry from an entrance examination for California Institute of Tech-

nology. That same problem was brought to me by a senior in this school who took the examinations. I teach a class in Plane Geometry which is composed almost entirely of sophomores and I suggested to them they work on the problem. I enclose three proofs, one worked out by a junior, one by a sophomore, and my own. We had discussed the first two in class and a pupil whose father is an engineer showed me the problem in your magazine.—*Florence B. Watson, St. Paul, Minn.*

Solution of James Hoivatt:



Given: Δ ABC and Δ DEF. BD = ⅓ AB = ½ AD, CE = ⅓ BC = ½ BE, AF = ⅓ AC = ½ CF. Δ ABC = 1.

Required: Δ DEF : Δ ABC = 1:?

I. Draw DG to midpoint of BE or G
Draw EI to midpoint of AD or I
Draw FG to midpoint of BE or G
Draw FI to midpoint of AD or I
Draw DH to midpoint of FC or H
Draw EH to midpoint of FC or H

Only one straight line may be drawn through two points.

II. $\frac{BD}{AD} = \frac{1}{2}$; $\frac{BG}{BC} = \frac{1}{2}$; $\frac{BI}{IA} = \frac{2}{1}$; $\frac{BE}{EC} = \frac{2}{1}$; $\frac{CE}{BE} = \frac{1}{2}$; $\frac{CH}{AH} = \frac{1}{2}$; $\frac{CG}{BG} = \frac{2}{1}$; $\frac{CF}{FA} = \frac{2}{1}$; $\frac{AI}{BI} = \frac{1}{2}$; $\frac{AF}{FC} = \frac{1}{2}$; $\frac{AD}{BD} = \frac{2}{1}$; $\frac{AH}{HC} = \frac{2}{1}$.

III. DG ∥ AC; IE ∥ AC; HE ∥ AB; FG ∥ AB; IF ∥ BC; DH ∥ BC.

A line which divides two sides of a triangle proportionally is parallel to the third side.

IV. DG ∥ IE ∥ AC; H ∥ FG ∥ AB; IF ∥ DH ∥ BC.

Lines parallel to the same line are parallel.

V. BG = DO = IF = OH = EC; BD = GO = EH = OF = IA; DG = IO = AF = OE = HC.

Segments of parallels cut off between parallels are equal.

VI. GJ = JO; DJ = JE; OK = KH; EK = KF; OL = LI; DL = LF.

A series of parallel lines cutting off equal segments on one transversal cut off equal segments on every transversal.

VII. DK, EL, and FJ are concurrent at O.

The medians of a triangle are concurrent.

VIII. Δ BDG + Δ DIO + Δ ODG + Δ GOE + Δ IAF + Δ FIO + Δ OFH + Δ HOE + Δ EHC = Δ ABC.

A whole equals the sum of its parts.

IX. Δ BDG = Δ DIO = Δ ODG = Δ GOE = Δ IAF = Δ FIO = Δ OFH = Δ HOE = Δ EHC.

A diagonal of a parallelogram divides it into two equal triangles.

X. Δ DGJ = Δ DJO; Δ EJG = Δ EJO; Δ EKH = Δ EKO; Δ FKH = Δ FKO; Δ FLO = Δ FLI; Δ DLO = Δ DIL.

A median of a triangle forms two equal triangles.

XI. Δ DGJ = Δ DJO = Δ EJG = Δ EJO = Δ EKH = Δ EKO = Δ FKH = Δ FKO = Δ FLO = Δ FLI = Δ DLO = Δ DLI.

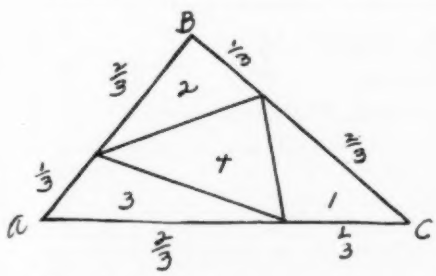
Halves of equals are equal.

XII. Δ DJO + Δ EJO + Δ EKO + Δ FKO + Δ FLO + Δ DLO = Δ DEF.

A whole equals the sum of its parts.

XIII. 9 triangles equal Δ ABC—Step VIII. 6 halves of those triangles or 3 whole triangles equal Δ DEF—Step XII.
Δ DEF: Δ ABC = 3:9
Δ DEF: Δ ABC = 1:3—Ans., ⅓.

Solution of Mary Ellen Johnson:



Given: Δ ABC = 1
⅓ AC and ⅔ BC are sides of Δ 1
⅓ BC and ⅔ BA are sides of Δ 2
⅓ AB and ⅔ AC are sides of Δ 3
Prove: Ratio of Δ 4 to Δ ABC.

I. $\frac{\Delta 1}{\Delta ABC} = \frac{\frac{AC}{3} \cdot \frac{2BC}{3}}{AC \cdot BC}$

$\frac{\Delta 1}{\Delta ABC} = \frac{AC \cdot BC\,(\frac{1}{3} \cdot \frac{2}{3})}{AC \cdot BC}$

$\frac{\Delta 1}{\Delta ABC} = \frac{2}{9}$

Triangles with an angle of one equal to an angle of another have the same ratio as the products of the sides including the equal angles.

II. $\frac{\Delta 2}{\Delta ABC} = \frac{\frac{BC}{3} \cdot \frac{2AB}{3}}{BC \cdot AB}$

$\frac{\Delta 2}{\Delta ABC} = \frac{BC \cdot AB\,(\frac{1}{3} \cdot \frac{2}{3})}{BC \cdot AB}$

$\frac{\Delta 2}{\Delta ABC} = \frac{2}{9}$

Triangles with an angle of one equal to an angle of another have the same ratio as the products of the sides including the equal angles.

III. $\frac{\Delta 3}{\Delta ABC} = \frac{\frac{AB}{3} \cdot \frac{2AC}{3}}{AB \cdot AC}$

$\frac{\Delta 3}{\Delta ABC} = \frac{AB \cdot AC(\frac{1}{3} \cdot \frac{2}{3})}{AB \cdot AC}$

$\frac{\Delta 3}{\Delta ABC} = \frac{2}{9}$

Triangles with an angle of one equal to an angle of another have the same ratio as the products of the sides including the equal angles.

IV. $\frac{\Delta 1}{\Delta ABC} + \frac{\Delta 2}{\Delta ABC} + \frac{\Delta 3}{\Delta ABC} = \frac{2}{9} + \frac{2}{9} + \frac{2}{9}$

$\frac{\Delta 1 + \Delta 2 + \Delta 3}{\Delta ABC} = \frac{2}{3}$

If equals are added to equals, the sums are equal.

V. $\frac{\Delta 1 + \Delta 2 + \Delta 3}{1} = \frac{2}{3}$

Substitute 1 for Δ ABC

VI. Δ 1 + Δ 2 + Δ 3 + Δ 4 = Δ ABC.

The whole equals the sum of its parts.

VII. $\frac{2}{3} + \Delta 4 = 1$

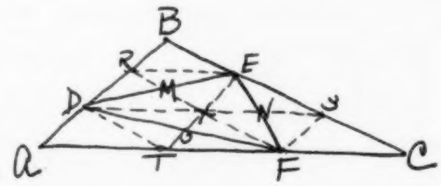
$\Delta \frac{4}{1} = 1 - \frac{2}{3} = \frac{1}{3}$

Substitute ⅔ for Δ 1 + Δ 2 + Δ 3, and 1 for Δ ABC.

VIII. $\frac{\Delta 4}{\Delta ABC} = \frac{1}{3}$

Substitute Δ ABC for 1.

Solution of Miss Florence B. Watson:



Given Δ ABC and Δ DEF. AD = ⅓ AB, BE = ⅓ BC, FE = ⅓ AC. Δ ABC = 1.

Required: The ratio of Δ DEF to Δ ABC.

I. Bisect DB at R, bisect EC at S, bisect AF at T.

A line may be bisected.

II. Draw RE, DS, DT, RF, SF and EF.

Two points determine a line.

III. DT ∥ BC, RF ∥ BC, TE ∥ AB, FS ∥ AB, DS ∥ AC, RE ∥ AC.

A line which divides two sides of a triangle proportionally is parallel to the third side.

IV. RE ∥ DS ∥ AC ∥ DT ∥ RF ∥ BC FE ∥ TE ∥ AB.

Parallels to the same line are parallel.

V. DO = OF, DM = ME, EN = NF.

Parallels which cut equal segments on one transversal cut equal segments on any other transversal.

VI. DN, MF and ET are concurrent at X.

The medians of a Δ are concurrent.

VII. AD × E = Δ DRE, Δ E × F = Δ FES, Δ D × F = Δ DTF.

A diagonal bisects a parallelogram.

VIII. Δ BRE = Δ RDE, Δ FSC = Δ FES, Δ ADT = Δ DTF.

Triangles with equal bases and attitudes are equal.

IX. Δ D × F = Δ DTE = Δ ADT, Δ D × E = Δ DRE = Δ BRE, Δ E × F = Δ FES = Δ FSC.

Things equal to the same thing are equal.

X. Δ D × E + Δ DRE + Δ BRE + Δ E × F + Δ FES + Δ FSC + Δ D × F + Δ DTF + Δ ADF = Δ ABC.

The whole equals the sum of its parts.

XI. 3 [ΔD × E + ΔD × F + ΔE × F] = Δ ABC.

Substitute and factor.

XII. 3 Δ DEF = Δ ABC.

The whole may be substituted for the sum of its parts.

XIII. $\Delta DEF = \frac{\Delta ABC}{3}$. Ans., ⅓.

Equals divided by equals are equals.

The number of trucks used by bakers and confectioners has grown from 3,000 in 1918 to 61,600 in 1938.

American Road

WASHINGTON, D. C.

ARBA PAST-PRESIDENT SMITH DIES

Down the Road

by CHARLES M. UPHAM
Engineer-Director,
American Road Builders' Association, Washington, D. C.

TO MARKET, TO MARKET, TO SELL A FINE COW

Swank diners at exclusive cafes in metropolitan centers little consider the part the American highway plays in supplying their high-priced menus with fine cuisine. From the deep cattle country to the West to the streamlined dining rooms of the East is a "long haul." Millions of miles are traversed each year to supply widespread markets and the state and national highways are paramount in this chain of commerce. So consistent has been the use of highway transportation to supply leading markets that, even through the depression years when expansion of most enterprises was curtailed, the graph computed by experts to show the use of roads traveled steadily upwards.

As early as 1912, livestock farmers were making widespread use of highway facilities to move their herds to shipping points. This system grew rapidly through the next four years. In 1916, when the trucked-in-receipts were first recorded, nearly one million head had arrived by road at seventeen leading markets. This was 1.6 per cent of the total receipts. With few exceptions, the percentage has increased through the years and today 53.4 percent of all livestock is marketed via the highway. Upwards of 38,000,000 head of cattle, hogs and sheep were transported over our highways in 1939. This figure approximates 60 per cent of the total tonnage of all animals marketed. It is estimated that 728,000 railroad cars would be required to haul these 6,500,000 tons of meat animals to points of treatment for distribution.

A recent report states that of the 2,662,000 truckloads checked in at various cattle exchanges during the year the average length of haul is 135 miles. This is ample indication that stockmen are selecting markets at distances of over 800 miles, because of the swift, efficient and advantageous transportation afforded by highways. Convenience and economy are other popular factors in this trend to the gasoline-and-tire route. Besides the well-developed, intersectional highways, secondary and feeder roads are important channels of operation in the extensive system of raising and preparing stock for market. Each year, terminal centers provide millions of head of feeder cattle and hogs that go back to farm feed lots over farm-to-market roads. On these rich and open plains, stock is fattened and finished for sale to great distributing organizations. Likewise, sheepmen in mountainous areas depend on the condition of mountain roads to enable them to reach the nutritious grasses that follow the retreating snowline. Such grazing country is invaluable for fattening lambs. Transporting this stock to rail sidings again emphasizes the need of well-built, good-surfaced roads.

Thus, modern highway programs throughout the various states concern stock raisers, because they can adjust their shipments to take advantage of favorable price trends, reach near-by trading centers and distant supply points, transport stock to comparatively inaccessible feeding grounds and, in short, take advantage of all timely moves in accordance with all prevailing conditions. As our great system of highways has become the lifeline of many nationally thriving industries, so has it established itself as the main artery of the cattle industry. This new and added traffic over farm-to-market highways increases the nation's road problem. It further establishes the right of the highway engineer to a seat among the high priests of America's futurama.

ARBA PAST-PRESIDENT SMITH DIES AFTER 50 YEARS AS ROAD BUILDER

When William Rice Smith died on April 5, the highway industry lost one of its outstanding pioneers and the American Road Builders' Association a great and well-loved leader. The 72-year-old president of the Lane Construction Corp., Meriden, Conn., was nationally known for the promotion of the highway-construction industry. In 1932, he was elected president of the American Road Builders' Association and was, at the time of his death, vice-president of the Highway Contractors' Division. He was also a director and past president of the Connecticut Road Builders' Association, ARBA affiliate. His death followed a heart attack at his Meriden home.

Mr. Smith was born in North Haven, Conn., October 17, 1867. He entered the crushed-stone industry at the age of 28 and was placed in charge of the Weehawken, N. J., quarries of the Lane Co. He became general manager of the Lane Corp. in 1902 and had been presidence since 1913. He served for many years on the ARBA board of directors.

More than 100 members of the Connecticut Road Builders' Association and the ARBA attended a testimonial banquet in his honor last September as a tribute to his 50-year experience in the road-building business. At that time he was presented with a plaque bearing the inscription, "This testimonial is presented to William R. Smith, the pioneer of the American Road Builders' Association, by his friends and admirers in the Connecticut Road Builders' Association." ARBA Engineer-Director Charles M. Upham, with other officers and directors of the association, attended the April 7 funeral.

SAND-GRAVEL ASSOCIATION ESTABLISHES FELLOWSHIP

The National Sand and Gravel Association has established a $600 annual fellowship at the University of Maryland. The fellowship is named for the association's director of engineering research, Stanton Walker. According to Dean S. S. Steinberg of the university's college of engineering, the grant will be awarded for research on appropriate problems related to the sand-and-gravel industry.

Builders' Review

Soldiers in 1420 built the first war tank. Rear-driven by six horses, it was steered by a foot-operated yoke acting on the front axle.

APRIL, 1940

AFTER 50 YEARS AS ROAD BUILDER

CONGRESSMEN, ARBA LEADERS ADDRESS MICHIGAN ROAD MEN

Congressman Wilburn Cartwright of Oklahoma, chairman, U. S. House Roads Committee; ARBA Engineer-Director Charles M. Upham, ARBA Past President and Michigan State Highway Commissioner Murray D. Van Wagoner and ARBA President Hal G. Sours, chief engineer and assistant director, Ohio department of highways, addressed more than 1,300 road men in Detroit, April 10. Other speakers at the annual meeting of the Michigan Road Builders' Association included Mayor Edward Jeffries of Detroit, Congressman Fred Bradley of Michigan, Herbert R. Anderson, president, ARBA Contractors' Division; Harry C. Coons, Michigan deputy highway commissioner and William C. Slee, ARBA assistant engineer-director. Floyd E. Koontz of Lansing was reappointed executive secretary of the ARBA affiliate. Newly elected officers are L. W. Edison, Grand Rapids, president; Walter Toebe, Walter Toebe & Co., Lansing, vice-president; P. M. Thornton, Thornton Construction Co., Hancock, Upper Peninsula, vice-president, and L. W. Lamb, Holland, secretary-treasurer. New directors include W. J. Storen, W. H. Storen Co., Detroit; John Yerington, Benton Harbor; A. W. Hodgkiss, A. W. Hodgkiss Co., Petoskey; John W. Hertel, Grand Rapids; I. L. Whitehead, Sault Ste. Marie; R. D. Baker, R. D. Baker Co., Royal Oak; Frank Loselle, Loselle Construction Co., Wyandotte, and E. B. Schwaderer, Cass City.

Diplomats, road builders and military experts heard Charles M. Upham address the American Legion in Washington. Photographed by Highway Information Service, left to right, are the Honorable Andres Pastoriza, minister of the Dominican Republic; Nicanor Alurralde, chief of technical and economic research, public roads authority, Buenos Aires, Argentina; Commander Thomas R. Callahan, Mr. Upham and William A. Van Duzer, District of Columbia director of vehicles and traffic and ARBA director. Mr. Upham's subject was "Defense Highways in the Western Hemisphere and in Europe."

TEXAS GROUPS STAGE SAFETY CONFERENCE

Traffic-safety programs on education, enforcement and engineering were featured at the Texas Safety Conference in Austin, April 16-17. Conducted under the auspices of the Texas Safety Association, Inc., and co-operating agencies, the conference presented awards to mayors of the state's safest cities for 1939. Speakers included Paul G. Hoffman, president, Automotive Safety Foundation; Dr. Miller McClintock, director, Yale University Bureau for Street Traffic Research; Frank M. Kreml, director, International Association of Chiefs of Police; Louis R. Morony, executive director, American Association of Motor-Vehicle Administrators; Grant Mickle, Michigan state traffic engineer; Sidney Williams, director, National Safety Council, and Leslie Sorenson, Chicago, Ill., traffic engineer.

AUTOMOTIVE SAFETY OPENS WASHINGTON, D.C., OFFICES

Headquarters of the Automotive Safety Foundation have been moved from New York City to Washington, D. C. The association's new offices in the Tower building were opened by Norman Damon, director, on April 22.

STATE HIGHWAY DATA PUBLISHED BY ARBA

"State Highway Information," new bulletin published by the American Road Builders' Association. lists personnel and purchasing methods of the forty-eight state highway departments. Estimated expenditures and mileage of highways by types to be constructed are covered in a forecast of 1940 state highway programs. Federal-aid appropriations, including unexpended balances and the 1941 allocations for each state, are covered. Formerly issued at intervals in mimeographed form, this information has been compiled into one bulletin by the ARBA Statistical Division. The new informational service is available free to ARBA members and priced at $1 to the general public.

HELM RE-ELECTED HEAD OF ASPHALT INSTITUTE

Joseph S. Helm, Standard Oil Co. of New Jersey, was re-elected president of the Asphalt Institute at the organization's recent annual meeting. J. E. Pennybacker was re-elected managing director. Mr. Pennybacker is a director of the American Road Builders' Association and Mr. Helm is a member of the ARBA Manufacturers' Division board.

CHEVALIER, DIMOND VISIT WASHINGTON

Colonel Willard Chevalier, ARBA past president and publisher, "Business Week," New York City, and George J. Dimond, Koehring Co., Milwaukee, Wis., were April visitors to the Washington offices of the American Road Builders' Association.

REFLECTING CURBS

Assist The Motorist To Read The Road He Travels

By WILLIAM VAN BREEMEN
Engineer of Special Assignments, New Jersey State Highway Department

DEVELOPMENT of the application of the principles of light reflection for increasing the night time visibility of highway structures is in its infancy. Development is slow because understanding has been slow. The limits of any one device have not yet been established. Choice of design features is still a matter of opinion and perhaps, of prejudice more than of experience. Many methods, still young, are competing for the demand. Mass production is needed because of imposed economy. That our highways of the future will have greater utility cannot be doubted. That this greater utility will be the result of research, study, and experimentation rather than the result of increased cost is probable. The development of the reflecting curb in New Jersey is only one of the many things that will help bring that greater utility. The application of the principles of light reflection from motor vehicle headlamps to highway curbs is only the first step in a long progression leading to better sight at night, therefore, greater highway safety.

After three years of experimental work with reflecting curb designs employing white cement New Jersey has proven its worth. Several miles of it are included in the 1940 program. Already a considerable quantity of earlier designs reflecting curb lies in its ability to employ headlamp power. Almost everything we see is light reflected to our eyes from an object. Therefore, for greater visibility the problem is to so design the highway structure as to return to the eye the greatest intensity of reflected light. There is nothing mysterious or even new about specular reflection. We have it whether we want it or not. On our streets and highways, at present, it is often as much of a hindrance as a help; but this need not be. Since headlamp power is projected in many directions all of it cannot be put to work for us. There is, however, a lot of it lost that could be used to advantage by considered design.

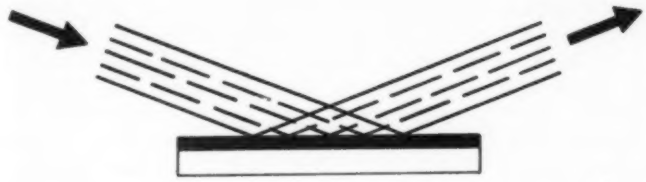
Fig. 1

Fig. 2

Curb Designs

Smooth Curbing.—Realizing that color plays an important part in the visibility of surfaces, the New Jersey State Highway Department adopted the use of white concrete materials for curb work several years ago. Figure 1 shows one of the earlier types of smooth white concrete curb poured in place at the time of construction. To reduce the collection of dirt, the exposed surfaces of the curb were finished as smooth as possible by means of a steel float. As can be seen, in the daytime the curb appears definitely whiter than the adjacent pavement.

At night, however, the results obtained by the adoption of white materials were quite disappointing. This is shown in Figure 2 which is a picture of the same stretch of smooth white curb taken on a dry night, under ordinary headlight illumination. Under these conditions the smooth white curb does not appear any whiter than the adjacent gray pavement surface. There is no strong contrast as in the daytime. In addition, to bring out the great change in visibility ordinary highway surfaces undergo in rainy weather, water was sprinkled on a portion of the curb and pavement surface. The contrast in visibility between the dry and wet surfaces is strikingly evident. The wet surfaces appear almost totally black. On rainy nights, this pronounced reduction in visibility naturally extends to all portions of the curb and pavement surface. Regardless of how white this smooth type of curb may appear in the daytime, it appears almost totally black to the driver on rainy nights. Furthermore, a considerable increase in the headlamp strength would not materially increase the visibility of these wet surfaces. This picture cannot fail to bring attention the marked degree in which water destroys the visibility of these types of surfaces. In addition, in this picture the same light source illuminates both the wet and the dry areas, and it therefore must be obvious that

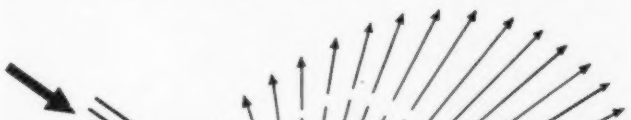


PLANE MIRROR SURFACE

Fig. 3

the character or condition of a surface has a great deal to do with whether it is visible or not.

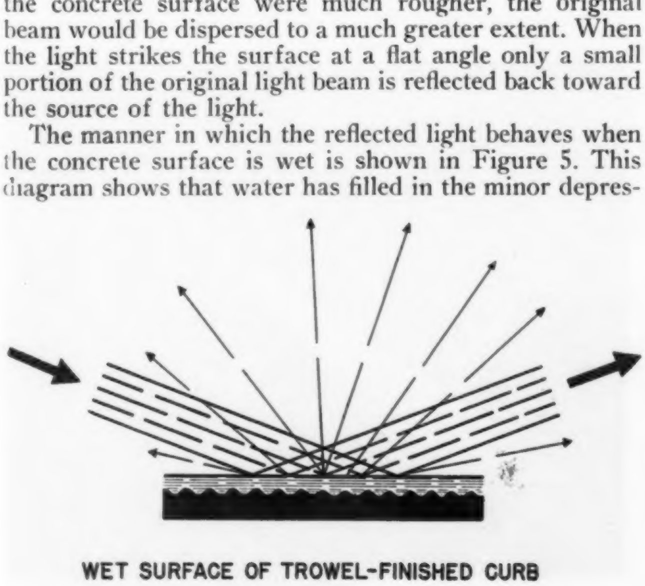
Reflection Analysis.—While all surfaces reflect more or less light, there is considerable variation in the manner in which they reflect it. The direction that the reflected light rays will take depends upon the formation of the surface. When, as in Figure 3, a beam of light strikes a flat, polished surface, such as a mirror, practically all of it is reflected in a definite direction. On the other hand, when a beam of light strikes a fairly smooth, dry concrete surface, as shown in Figure 4, the reflected light is scattered in many directions. This diagram shows graphically how the original ray is dispersed. Note that most of the light is dispersed forward and upward. If the concrete surface were much smoother than shown here, the reflected light would tend to be concentrated within a single beam, as in a true mirror. If, however, the concrete surface were much rougher, the original beam would be dispersed to a much greater extent. When the light strikes the surface at a flat angle only a small portion of the original light beam is reflected back toward the source of the light.



DRY SURFACE OF TROWEL-FINISHED CURB

Fig. 4

The manner in which the reflected light behaves when the concrete surface is wet is shown in Figure 5. This diagram shows that water has filled in the minor depressions in the concrete surface—and that the upper surface of the water film is comparatively smooth. The upper surface of the water film possesses certain of the critical reflecting properties of a true mirror. When light strikes the water surface at a flat angle most of the light is reflected from it in a definite forward direction. The residual light which penetrates the water film undergoes diffusion by contact with the comparatively rough concrete surface. Some of the diffused rays pass back through the water film into space while the remainder are evidently dissipated within the water film itself by internal reflection. In this condition, practically *none* of the light is reflected back toward the source.



WET SURFACE OF TROWEL-FINISHED CURB

Fig. 5

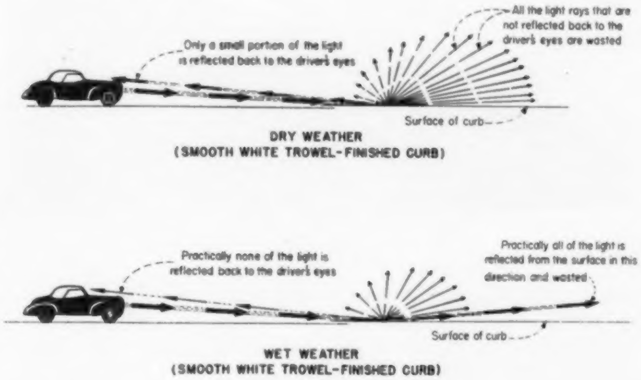


Fig. 6

Figure 6 shows how the foregoing principles apply to conditions on the road.

The upper diagram shows a dry weather condition. The light strikes the surface of the *smooth,* white curb at a very flat angle. Most of the reflected light leaves the surface in a forward and upward direction. Only a small portion of it is reflected back toward the driver. Because the curb surface reflects very little light back to the driver's eyes it is evident that the curb is not especially visible to him. The manner in which the light is reflected from the smooth surface has greatly reduced the effectiveness of the white materials, and the curb appears decidedly gray.

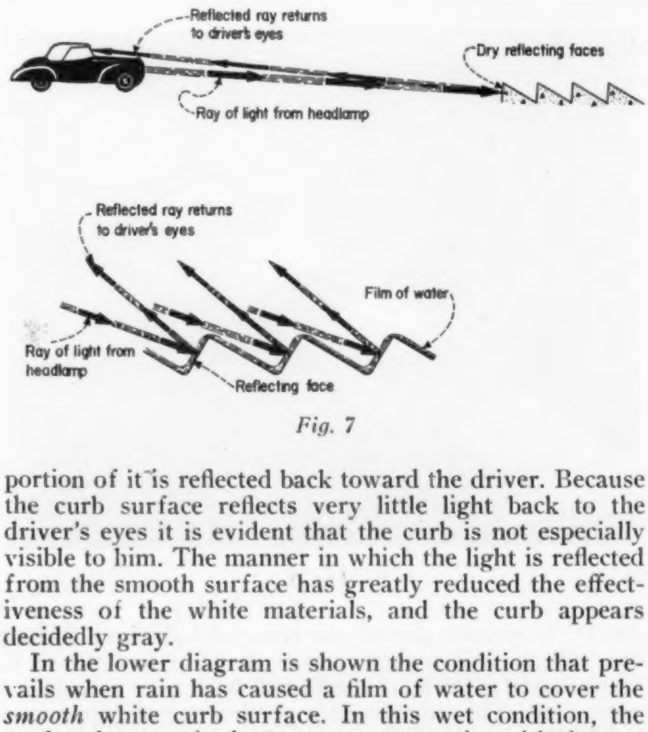


Fig. 7

In the lower diagram is shown the condition that prevails when rain has caused a film of water to cover the *smooth* white curb surface. In this wet condition, the surface has acquired, to a great extent, the critical properties of a true mirror. Almost all the reflected light leaves the surface in a definite forward direction. Practically none of the reflected light reaches the driver's eyes and, as a result, the wet curb surface appears almost totally black to him. Wet pavement surfaces also appear

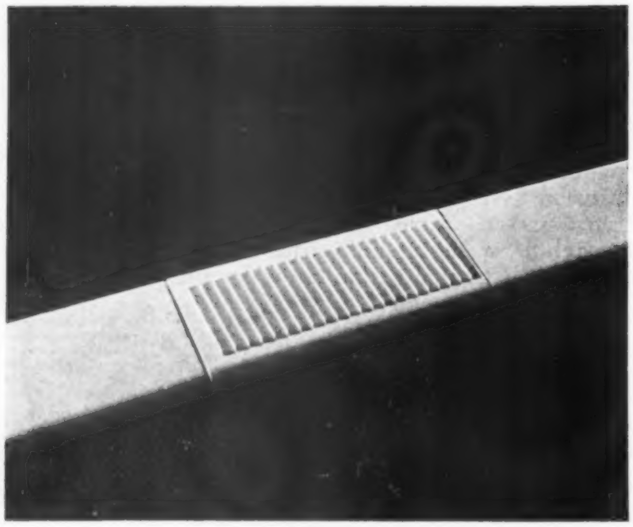


Fig. 8

almost totally black under these conditions for the same reason. When wet, surfaces of this type waste almost all the light that comes from the headlamps, and entirely destroy the value of the white concrete materials. These surfaces must be corrected if the best advantage is to be obtained from the light and the materials.

The upper diagram in Figure 7 shows in an exaggerated manner how a surface may be constructed so as to eliminate this great waste of reflected light. A surface of this type directs practically all of the reflected light back toward the driver's eyes. Wet or dry, a concrete surface constructed in this manner is *very* much more visible than a smooth one. This type of surface consists of a series of reflecting faces lying approximately perpendicular to the headlamp rays. These reflecting faces

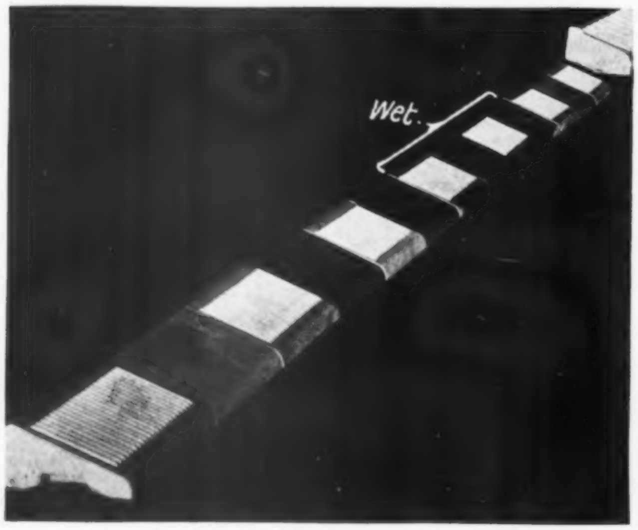


***Fig.* 9**

direct the greater part of the reflected light back toward the vehicle. When light strikes them, it is diffused to some extent; that is, it is reflected back over a considerable area. The angular change that takes place as a vehicle travels nearby and parallel to the curb is small while any particular face is in view, and the extent of the diffusion exceeds, and compensates for, this angle change.

As already noted, on a wet night all ordinary surfaces appear almost totally black. However, the same conditions which produce this unhappy result fortunately *increase* the visibility of a properly designed surface. The lower diagram in Figure 7 shows the presence of a water film on a series of reflecting faces. The film of water tends to produce a true mirror effect and the intensity or brightness of the reflected light is *greater* than from a dry surface. Therefore, the reflecting faces stand out brightest and sharpest on wet nights—just when their help is needed most.

The practical application of a series of reflecting faces to a concrete surface is shown in Figure 8. This comparatively simple design was incorporated in the surface of a small, experimental section of pre-cast white concrete curb. Adjoining it are two sections of smooth curb.

In order to make a comparison between the visibility of smooth curb and reflecting curb of this type, several sections of each were poured and arranged alternately in a row. This is a portion of that row. In their manufacture, white concrete materials of the same mix were

***Fig.* 10**

used throughout. All surfaces of the smooth and reflecting sections are practically of equal whiteness.

Figure 9 is a dry night photograph of the row of experimental sections just mentioned. It gives a direct comparison between the visibility of smooth and reflecting curbs—as seen by the night driver. Four of the

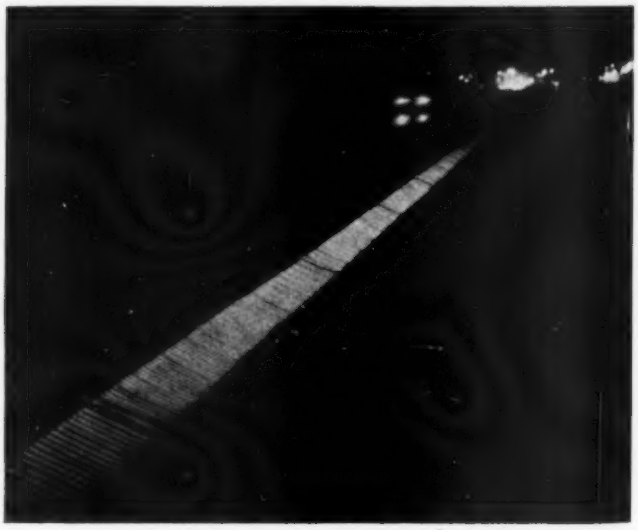


Fig. 11

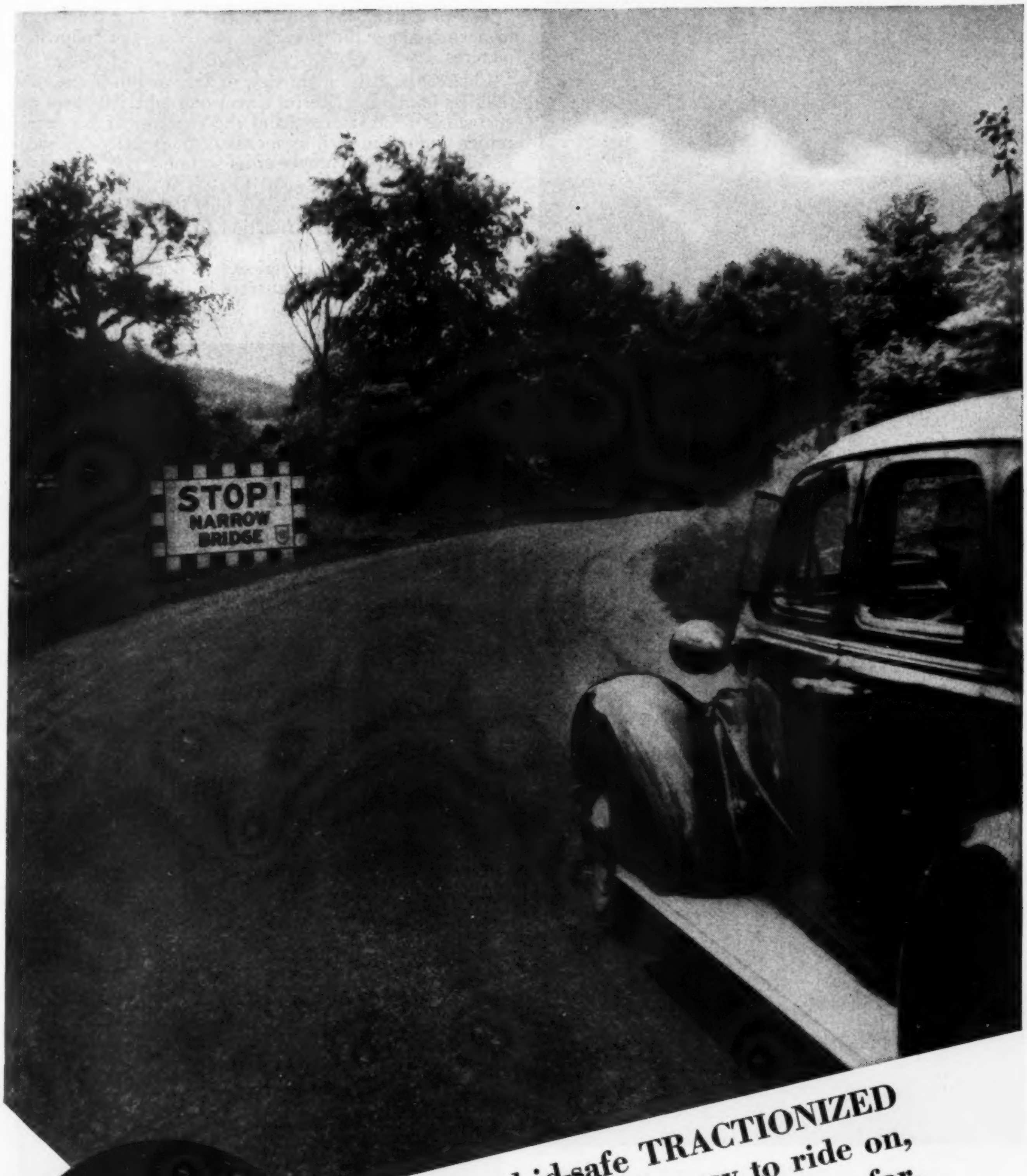

STOP!
NARROW
BRIDGE

Fig. 12

sections indicated have been sprinkled with water. The smooth portions of the curb sections that are wet appear almost totally black, and the series of wet reflecting faces stand out in sharp contrast to the surrounding blackness. Some of the smooth dry sections of curb appear darker than others. This is only because the darker sections have a slightly smoother surface finish and consequently reflect most of the light ahead rather than back to the eye.

This comparatively simple, though effective, design embodies the basic principles employed in the New Jersey reflecting curb. This picture shows the results that are obtainable by simply constructing a series of reflecting faces that lie approximately perpendicular to the

Fig. 13

headlamp rays. Many refinements have been incorporated in their latest designs of curb with a corresponding increase in efficiency. They have, for example, taken advantage of the way a water film causes the concrete reflecting faces to acquire the critical qualities of a true mirror. In order to utilize these qualities and coordinate them with the change of position of the vehicle, curvature and variable vertical inclination have been incorporated in the reflecting faces. In wet weather those portions of the reflecting surfaces that meet theoretical requirements reflect a high intensity of light—and a very distinct gleam is seen on those surfaces.

The practical application of the foregoing principles to a curb along the paving is shown in the following pictures.

Figure 10 is a dry night view of a poured-in-place curb that has been in service for a year and a half. The upper surface is white mortar, and the reflecting faces were rather crudely formed by means of a specially designed finishing tool of the proper cross-section.

Figure 11 shows a rainy night view of the same stretch of hand-tooled curb. It shows how even those crudely formed reflecting faces function to distinctly good advantage on a night like this. It might be said at this point that, in New Jersey's experience, it does not appear to cost any more to tool the surface in this manner than to trowel it smooth. But the results are strikingly evident.

Fig. 14

Note also that the presence of water has caused the white painted pavement stripe, visible in dry weather in Figure 10, to become invisible.

Figure 12 shows a rainy night view of two designs of pre-cast reflecting curb in an area illuminated by overhead lights. In the foreground is shown a stretch of 1938 design pre-cast curb. This is the first design of pre-cast reflecting curb used by this state. Joining it, and continuing into the background is 1939 design pre-cast curb.

Fig. 15

Fig. 16

In addition to showing the effectiveness of reflecting curb in well illuminated areas, especially on rainy nights, this picture shows the distinct improvement in reflecting efficiency made after one year's experience and study. For all practical purposes the same intensity of light strikes both types of curb in the vicinity of their point of juncture, and their comparative efficiency is readily observed at this point. Fig. 13 shows a narrow type of dividing island on a dry night. This 27-in. width curb, installed on a bridge, has a series of reflecting faces on each side of the center crown. The same stretch of 27-in. curb is shown in Fig. 14, on a rainy night.

Earlier in this paper, mention was made of a gleam

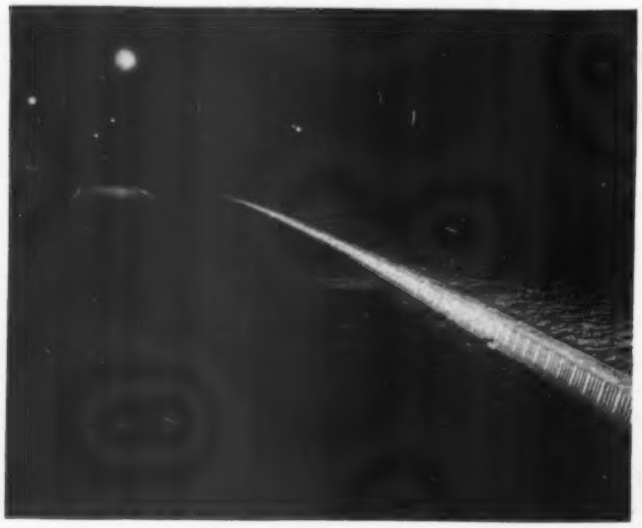


Fig. 17

that occurs during wet weather on those portions of the reflecting faces that conform to theoretical requirements. This picture was under-exposed in order to capture the details of the gleam which may be seen extending diagonally across the band of reflecting faces. Had this picture been exposed long enought to bring out surrounding structures the entire band of reflecting faces would appear as a white bar.

Figure 15, taken on a dry night, shows the design adopted for the curved ends of islands. Because of considerable cross and turning traffic the design contemplate making these radial sections visible from many points. The same location on a rainy night is shown in Fig. 16. This picture brings out the sharp contrast in visibility between the series of reflecting faces and the extremely dark adjacent surfaces.

Figure 17, which is a dry night view at a point well illuminated by overhead lights, shows the application of a series of reflecting faces to a 200-ft. stretch of vertical type of curb. This curb was poured-in-place and the series of reflecting faces in the vertical portion were formed by pouring against a negative front form.

The same stretch of reflecting vertical curb is shown in Figure 18 on a rainy night.

Returning to the sloping type of curb, Figure 19 shows a comparison between the 1939 and 1940 designs.

***Fig.* 18**

The 1940 curb shown to the right is narrower, and costs less. However, it has two and one-half times as many reflecting faces per foot of curb as the 1939 design. Consequently, the reflecting efficiency of the 1940 design is considerably higher than any types previously designed.

The reflecting faces are spaced approximately 3½ in. apart, but are not alike. There are three distinct types varying in height and curvature. Some are designed to be most efficient in the distance while others work to best advantage nearby. The 1940 sloping type reflecting curb produces a continuous band of reflected light from 40 ft. ahead of the vehicle to a point where the headlimps are no longer effective.

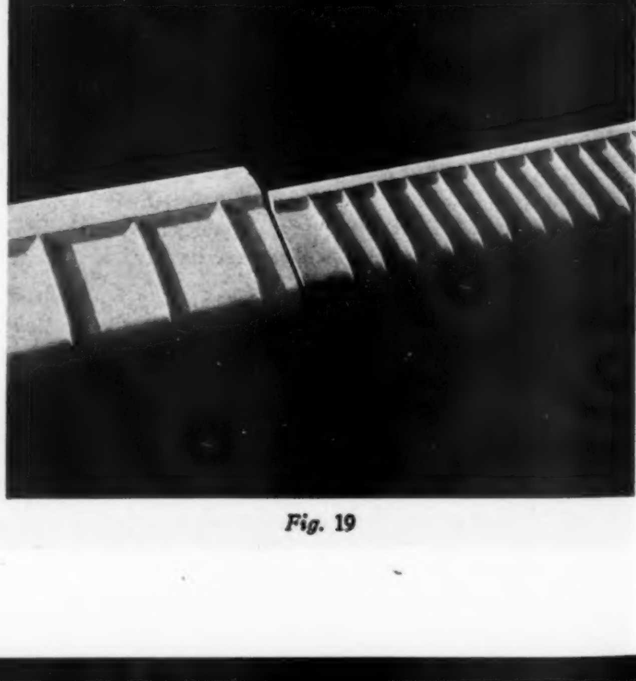


***Fig.* 19**


SPEED
. . . to keep truckers "humping."
. . . to make extra yardage on easy going.
. . . to get each full dipper up and out by the time it swings over to dumping position.
. . . to retract twice as fast as it crowds.
. . . to dump sticky materials with vigorous crowd-retract shake.
. . . to drop more dollars in your pocket more quickly.
11 Fully convertible models in 3/8-1/2-5/8-3/4 yd. sizes
BYERS
RAVENNA, OHIO
SPECIALIZING IN Portable SHOVELS AND CRANES

POST THE OLD BRIDGES

Upon A Rational Basis

Uniform Vehicle Codes and Uniform Existing Bridge Load-Rating Standards Needed

PEOPLE who use the highways place their faith blindly in the hands of highway engineers, particularly in highway bridge engineers. They can't see if a bridge is safe as they approach it or ride over it. A slide, a slip-out or a pot hole in a road are things which they can see and avoid injury or damage, but how about rotted timber stringers, broken chords of a pin connected truss or a scoured out footing and heavy trucks pounding along the road at high speeds?

In addition to hidden structural weakness there are the hazards to traffic similar to those which occur at other parts of the highway,—narrow roadway widths with heavy traffic, impaired clearances, and sharp curves are all a part of the present day problem with which bridge and highway planning engineers must cope. This is the "Old Bridge Problem."*

There are many sides to the problem, such as the classification of bridges with regard to their safety and load carrying capacities, the responsibility of public officials charged with their upkeep and the financial problem connected with bringing not only state highway bridges but a multitude of others on county and township roads and city streets up to anything like a desirable modern standard.

Checking Existing Bridges

Different rules for checking the load carrying abilities of existing bridges must be employed than for the design of new structures. New bridge designing rules are quite well established and almost universally accepted among engineers. They are, it is claimed, based on engineering logic, experiment and experience. Ancient tradition and the "dash board disease," however, are powerful factors, as is that vague something called "good practice." It has been well said that "the specifications used are the result of a slow evolution from crude assumptions made many years ago." The crude assumptions are even yet right on the heels of the evolution. The factors of safety which new design provides allow for a tremendous increase in highway loads. There are, of course, some uncertainties regarding the future loads and the construction conditions, but are they so great as to require the large safety factors employed?

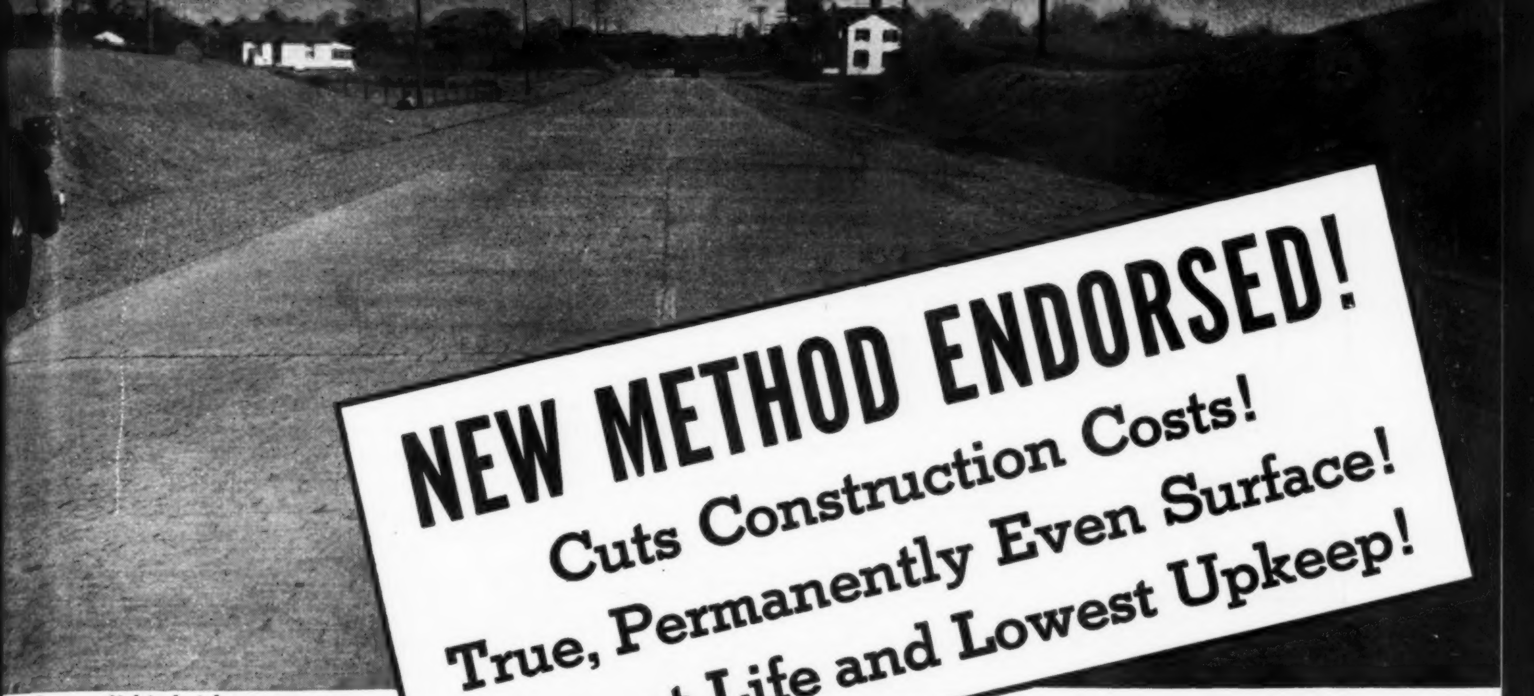
In the case of existing structures, bridges are carrying more severe loadings than those for which they were designed. In other words, they've been overloaded innumerable times. Yet there they stand. They have suffered a certain amount of deterioration. Hence it becomes a matter of considerable importance to determine, with some fair degree of approximation at least, just how much of a safety factor remains under the actual conditions. In making this determination rules for checking must be different from rules for design. Old bridge checking specifications provide a basis for computing the maximum loads that may be allowed on a bridge when materials are of the best commercial quality or grade, members acting normally, and deductions in section areas have been made for deteriorated portions. In determining the safety factors existing, the absolute live load safety to all types of vehicles must be kept in mind. The adoption of large safety factors (by unit stress values employed in the calculations) may cause unnecessary hardship on economic hauling.

When designing a new bridge simplified formulae may be used, which give satisfactory results within the limits set up by the specifications covering the quality of materials, workmanship, and the size and shape of members. In the case of existing bridges the condition and kind of materials and workmanship may be considerably outside the limits commonly employed for new bridges. To extend design formulae to cover such conditions may lead to absurdities. Also, in design, accepted rules generally provide an extra large factor of safety in members of connections when the increased cost is small and when, by so doing, it is likely that future maintenance will be less and service life prolonged. The application of such rules to existing bridges would unnecessarily restrict hauling. Particularly is this true where extra maintenance cost becomes secondary as often occurs when the economics of a situation are considered.

When rating an existing bridge, only the present and immediate future conditions need be considered. Factors of safety are established by employing the loadings of actually observed equipment giving the most critical conditions, limiting maximum stresses in the materials to less than the elastic limits (or breaking points in the case of certain materials), and using formulae for the distribution of loads to various parts of the structure that are on the safe side. To prevent unreasonable restrictions against hauling, liberal safety factors must be employed. Since the bridge has stood up under repeated overloadings, close approximation of the working safety factor is possible. The primary problem in finding the safe load carrying capacity of an old bridge is, therefore, to determine the magnitude of safety factors and so proportion them that the structure will be reasonably safe but, at the same time, will not set up prohibitive restrictions on the majority of truck hauling. The use of broad assumptions or the sacrifice of too much accuracy in favor of standardization cannot be justified on the basis of uncertainty as to future loads. Coordinately, the relative seriousness of the various kinds of failures is a matter which should be considered when deciding upon proper safety factors.

In California some of those who complain about placing restrictions on bridges in their communities are

* Mr. F. W. Panhorst, Bridge Engineer of the California Division of Highways, discussed this subject at the annual convention of the American Association of State Highway Officials at Richmond, Va., on Oct. 10, 1939.



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U. S. 21, Stark County, Ohio

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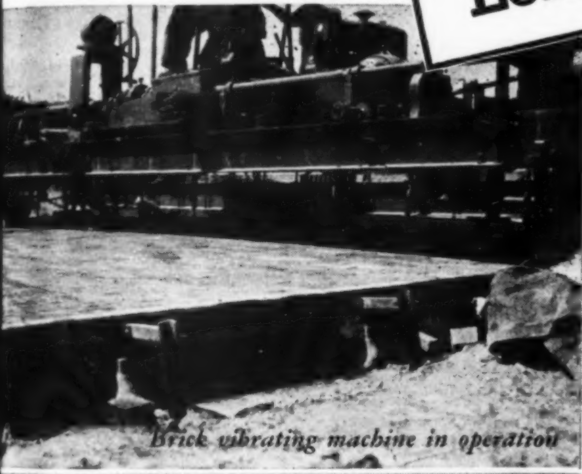
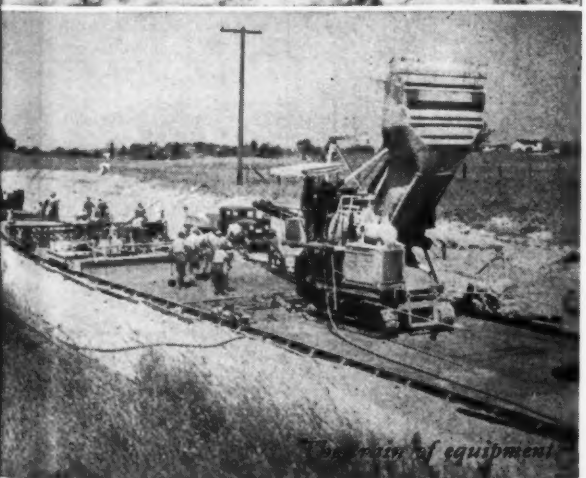
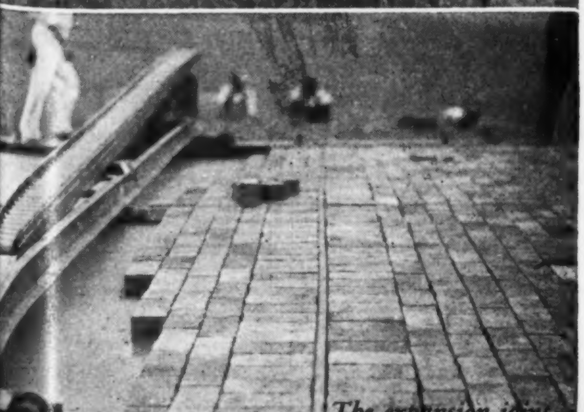


Brick vibrating machine in operation



The train of equipment



The expansion joint

● Using this new and approved construction method you can now build brick roads with a perfect traffic surface at a substantially lower cost! It is called vibrated monolithic brick.

Vibrating machinery, recently developed, makes this possible. In this method of construction, the brick are vibrated into the freshly placed concrete. Expansion and control joints are used. Grout filler completes the job.

Vibrated monolithic brick construction gives the low upkeep and long life characteristic of brick. The surface is permanently true and in alignment. The hard, impervious brick protects the softer and porous base just as the hard and impervious enamel of a tooth protects the softer structure which it covers.

Monolithic grout-filled brick construction has always had many supporters. Now vibration perfects and simplifies the construction—gives an ideal surface, and makes a handsome reduction in cost.

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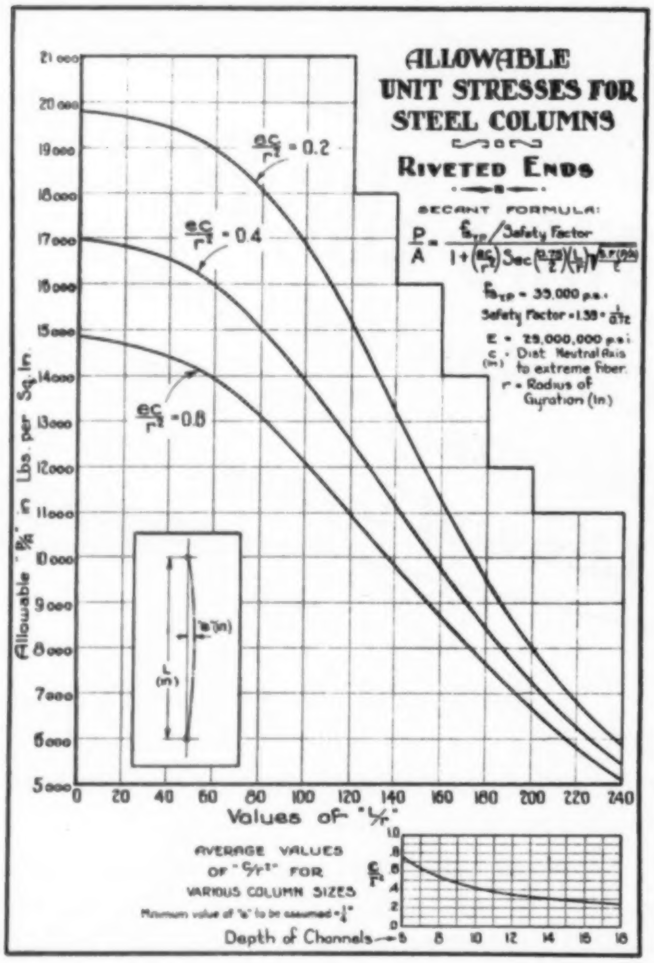
VIBRATED MONOLITHIC

BRICK

FOR HIGHWAY SURFACES



the local people as well as the truck haulers. These same people have, also, openly boasted about hauling large extra tonnage over the loads posted; but, should one of these suffer a loss from the failure of a bridge, mayhap due to his own carelessness, and what happens? The vehicle owner employs engineers to testify that the generally accepted design stresses were exceeded and claims that in consequence of that fact failure of the structure occurred. Hence, it is deduced that the public officials were negligent in not posting the bridge according to the *usual* design stresses employed. Herein lies the point of friction between the "old bridge" problem and the new design problem. A clear cut line must be drawn between the two problems and separate, individualistic standards established for rating existing bridges. It is a vital necessity to have uniformity in all states both in the design of new bridges and in the rating of old ones, and to assist in this it becomes very desirable that a uniform code be adopted throughout the United States to limit axle loads and axle spacing for vehicles using the highways.

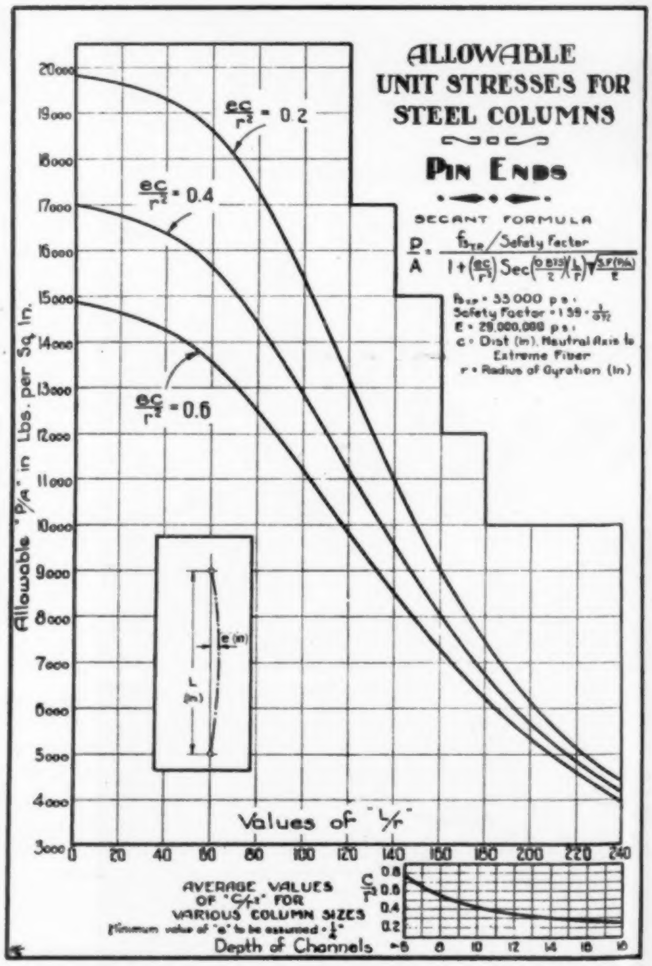
Example of Specifications

The California Division of Highways has done a great deal of work in connection with determining reasonable weight limits for actual vehicles which use the highways, and have also prepared a set of limiting specifications for checking live load capacity of existing bridges as a guide to the safe load which any bridge, old or new, can carry safely.

An example of these specifications is shown herewith, being taken from pages 9 and 10 of their limiting specifications, in order to show how they vary from the usual design practice. The figures given, as the introduction to the specifications state, provide a basis for computing the maximum loads which may be allowed on a bridge constructed of materials of the best commercial quality, if members are acting normally, and if deductions in area have been made to cover deteriorated portions. They assume that the bridges are subject to competent inspection as often as the condition of the structure requires and that the investigating engineer will exercise sound judgment in determining the increased safety factor to be used when the above conditions do not exist. Higher stresses than are used in design are used under these conditions, chiefly because of the fact that the establishing of the safe capacity is only a temporary procedure under fairly well known conditions and can be changed whenever the conditions warrant it.

It is very often the case that the economics of the situation make it advisable to permit heavier loads than would ordinarily be considered good practice from the standpoint of increased maintenance or shorter service life. It is also true that in bridge inspections actual conditions tending to reduce strength can be observed and more definitely allowed for. Likewise, the usual limiting specifications for fabricating material which accompany the construction of a new bridge, and which are taken into account in design practice, do not hold. The California rating specifications take this into account in the column formula shown which goes beyond the limits of the ordinary design specification formula and allows reasonable modifications to be made for bends or eccentricities in the load application, lack of lacing bars, etc.

With regard to matters not definitely covered by the rating specifications, it is stated that the current Standard



Specifications used for design of new bridges shall be used as a guide but that they may be modified, within safe limits, if knowledge of the actual members is sufficiently definite to allow the application of more accurate mechanical principles.

2. STRUCTURAL STEEL

The following are *maximum* allowable basic unit stresses in lb./sq. in., for structural steel:

a. Axial tension, net section, structural members........24,000
b. Axial tension, bolts, rods........18,000
Area at root of thread.
c. Tension in extreme fiber due to bending........27.000
Stringers subject to passing loads........24,000
d. Tension or compression in extreme fiber, in pins, due to bending........48,000
(Not to be computed where lever arm of couple is less than the diameter of pin)
e. Axial compression, gross section, for steel columns........See Formula

$$\frac{P}{A} = \frac{fy/SF}{1 + \left(\frac{ec}{r^2}\right) \text{Sec} \left(\frac{B}{2}\right) \left(\frac{L}{r}\right) \sqrt{\frac{SF(P/A)}{E}}}$$

Riveted Ends: ....B = 0.75
Pin Ends: ....B = 0.875

P = Total axial load in lbs.
A = Area of gross section in sq. in.
fy = Yield point of strength of steel, lbs./sq. in.
SF = Safety factor = 1.39.
e = Bend in column or eccentricity in load application, in inches. Min. value = ¼".
c = Distance from neutral axis to extreme fiber, in inches.
r = Radius of gyration.
E = Modulus of elasticity.

f. Batten plate columns:
The allowable unit stresses obtained from Sec. (e) shall be reduced to the following percentages for compression members tied with batten plates:

Spacing of Batten Plates	Per cent of Stress Allowed by Column Formula: Batten Pls. both sides of Column	Solid Pl. one side and Batten Pls. other side
Up to 2 d	100%	100%
3.5 d	75%	85%
6 d	50%	75%
10 d	....	50%

d = Depth of channels.

g. Compression due to bending in flanges of floorbeams, girders and rolled beams

$$\frac{27.000}{1 + \frac{1}{2000}\left(\frac{L}{b}\right)^2}$$

L = Distance, in inches, between points of definite lateral support. Well seated and properly bearing timber stringers may be considered as furnishing adequate lat. support.
b = Flange width of beam or girder, in inches.

h. Shear in pins, rivets and turned bolts:........18,000
i. Shear in unfinished bolts:........12,000
j. Bearing: 36,000
(Ordinarily not considered unless there is a visible deformation of the parts in contact.)

The charts of allowable unit stresses for steel columns (riveted ends and pin ends) simplify the determination of the formula given above.

Texas Conference on Traffic Engineering—A conference on traffic engineering sponsored by the College of Engineering of the University of Texas, Austin, Tex., will be held at the university July 15 to July 20th, inclusive. The conference, which is under the direction of John A. Focht, Professor of Highway Engineering of the University of Texas, is the first gathering of this type to be held in Texas. The conference is opened to all public officials in the United States and Mexico.

STATE HIGHWAY ROUTES THROUGH INDIANA CITIES

In 1937 the State Legislature of Indiana passed a law providing that the state highway commission should select, mark, and maintain routes for state highway traffic through all cities and towns with the exception of cities of the first class, which eliminated Indianapolis. This law affected the maintenance and improvement of streets in 79 Indiana cities and added 410 miles to the then existing state highway system. These streets, carrying state highway traffic through the 79 cities had been built, maintained and improved by the municipalities. Transfer to the state highway system meant that the maintenance and improvement became a responsibility of the state highway commission. Some interesting information on this work was given by Howard Atcheson, member of the commission, in a paper presented at the 26th annual Purdue Road School.

For the most part, the streets which carry state highway traffic through the 79 cities are subjected to unusually heavy traffic, not made up entirely of vehicles traveling the state highway system. In most cases these streets also carry a high percentage of the local or city traffic.

This means that the problems of maintenance, improvement, and traffic regulation on these 410 miles of highway routes in cities having a population of more than 3,500 are more numerous and more expensive to solve than on any other similar mileage in the state system.

During the past fiscal year, the state highway commission spent $415,039.42 in maintenance of the 410 miles of state highway routes in the 79 cities. This represents an average maintenance expenditure of approximately $1,000 a mile, or nearly double the average maintenance cost per mile of the entire state highway system for the fiscal year.

Maintenance of the state highway routes in cities of more than 3,500, under legislation enacted by the 1937 General Assembly, placed additional responsibilities on the state highway commission. Among these are: The cleaning of the streets, patching and repairing surfaces, maintenance of traffic lights and signals, the marking of surfaces to designate proper parking and lanes for pedestrian movement, the removal of snow and ice in winter, and the establishment of traffic regulations governing the movement of vehicles on these routes. It has been necessary for the commission, in carrying out the responsibilities imposed by the General Assembly, to send its engineers into the cities and towns traversed by state highways for studies of traffic conditions in order that they could intelligently make recommendations for traffic control.

The major item of expense of state highway routes in the 79 cities and towns has been the construction and reconstruction necessary to place these streets in good condition. During the past fiscal year, 58 miles of streets were resurfaced in 43 of the 79 cities while other construction work was completed, including paving and the building of bridges and grade separations. Resurfacing and other construction work on these highway routes through cities represented an expenditure for the fiscal year of $1,350,617.30.

This expenditure may seem startling, especially in comparison with construction costs on rural highways in the state system, but it should be remembered, that where surfaces on rural highways are 18 to 20 feet in width, the city streets which were improved were from 36 to 56 feet in width—two to three times the width of the rural highways.

OMAHA AIRPORT RUNWAYS

Their Design, Construction, and Performance

By W. H. CAMPEN
Omaha Testing Laboratories
Omaha, Nebraska

IN recent years much valuable data have been gathered, both in the laboratory and in the field, on the stabilization of soils and soil-aggregate mixtures.* Hand in hand with this development a number of formulas have been suggested for the estimation of the load carrying capacities of these materials when used in road beds. In all cases the authors admit that some of the factors in the formulas can not be determined satisfactorily in the laboratory. Therefore, observations on the performance of actual road beds are needed to establish the value of these factors. Submitted herewith are some tests and observations made in connection with the construction and performance of the Omaha airport runways as a major example of clay bound road beds. The actual performance is compared with the calculated results obtained by using the formula developed by Prof. W. S. Downs and later modified by Mr. B. E. Gray.

General Data

Construction of the runways at the Omaha Municipal Airport was started in the summer of 1936 and continued until the fall of 1938. A total of about 12,000 running feet of runways, 150 ft. in width, were constructed, totaling approximately 200,000 sq. yds.

In general the cross section of the runways will show 6 in. of compacted soil, called the sub-base, 5 to 10 in. of compacted soil-sand gravel, called the base, and either 2 in. of coarse asphaltic concrete with a 1-in. sheet asphalt wearing surface or 1½ in. of asphaltic concrete with a ½-in. sheet asphalt surface.

Originally the area on which the airport runways are built were a part of the Missouri River bed. Later some filling was done with dredged material taken from an adjoining lake. The runways are provided with excellent surface drainage and some of them are also drained subterraneously. All drained water is conducted to sumps from which the water is pumped into a lake by automatic electric pumps.

Soil Survey and Borrow Pits

A soil survey to a depth of at least 36 in. below the finished surface revealed the fact that the finished pavement would be supported by three main types of soils: silty clay, clay loam, and cohesionless fine sand. Some properties of these soils are shown in Table I.

At the time the soil survey was made it was known that a great deal of filling would be necessary. With this in view a search was made for suitable borrow pits. Some excellent soil deposits were found on the site. The analysis of two typical ones are shown in Table I under Soil No. 1 and No. 2.

Preliminary Laboratory Work on Sub-grade and Sub-base Soils.—After the soil survey was completed the sub-grade and sub-base soils were examined for load bearing value, and volume changes due to drying, freezing, and capillary water. First of all the soils were compacted by the Proctor method and in addition to the usual data obtained in this process the air voids were calculated at each trial. Whenever the air voids were in excess of 3 per cent at optimum density the height of the hammer was increased. This modification is necessary because we had learned by means of capillary tests that compacted soil mixtures will take up water until the air voids are reduced to about 3 per cent. It is evident that soils which contain more than 3 per cent air voids at optimum density are not stable if submitted to the action of water by capillarity. Our experience has shown that soils with a P. I. of over 30 have excess air voids when packed by the usual Proctor method.

After the desired density had been obtained with the various soils, a series of tests were run in which the relation between water content and load bearing value was determined. The load bearing value was determined by compacting the soils 4 in. deep in an 8-in. diameter mold and then applying static loads at the center by means of a 2-in. diameter bearing block. The load was applied until the bearing block deformed the surface ⅛ in. After 5 min. the load on the bearing block was read on the machine dials. The results of these tests are shown in Table II and Curves A, B, C, D. It will be observed that all soils have load bearing values of at least 100 lb. per sq. in. at optimum density. It will also be noticed that all soils have a critical point, that is, within a very narrow water content variation the load bearing value changes abruptly. No doubt the true plastic limit of the soil is in this region.

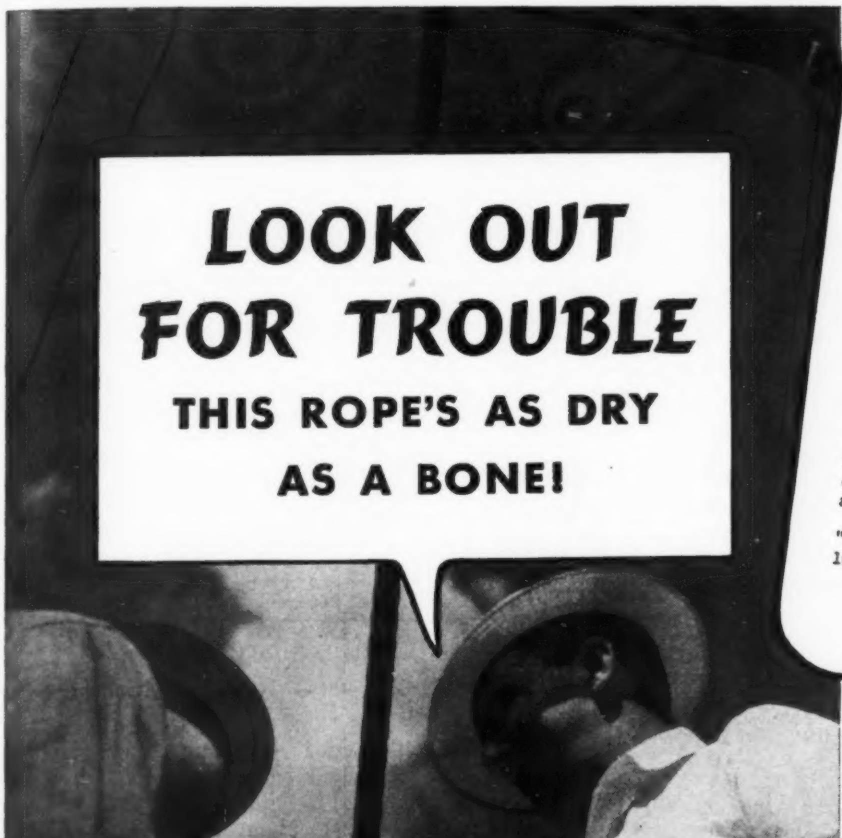
To determine the effect of drying, freezing, and capillary water samples were molded at optimum density. The linear shrinkage due to drying was determined by measuring the diameter of the specimen immediately after molding and after drying to constant weight in the air. We attempted to measure the expansion due to freezing by measuring the diameter immediately after casting and after freezing at 10 deg. below zero F. for

TABLE I

Characteristics of Sub-Grade Soils

	Sand	Silty Clay	Clay Loam	Soil No. 1	Soil No. 2
Total clay		37.8%	24.2%	17.7%	21.5%
Silt		59.6%	38.9%	29.2%	34.5%
Sand Passing a No. 40 sieve	100%	1.6%	36.9%	53.1%	44.0%
Specific gravity	2.60	2.68	2.62	2.62	2.62
Liquid limit		80.4	50.4	32.1	43.0
Plastic limit		28.3	20.5	15.8	20.0
Plasticity index		52.1	29.9	16.3	23.0
Linear shrinkage					
After drying		5.8%	4.4%	2.2%	3.3%
After freezing-drying		4.4%	3.1%	1.8%	2.4%
Expansion after freezing		1.4%	1.3%	0.4%	0.9%

*By means of clay and water, cement and water, and bituminous products.



FROM THE DAILY REPORT OF A TIGER BRAND WIRE ROPE ENGINEER

Was out on a job with Mr. Long this A.M. when I came across a wire rope that was badly in need of lubrication. "Look out for trouble here," I told him, "this rope's as dry as a bone."

He looked it over. "Looks okay to me," he said, "not much wear."

"That's just the point," I told him. "You can't see what goes on inside a rope When it's not lubricated, the external appearance may deceive you. The inside wires may be badly worn and corroded and even broken from abrasion and binding."

"Better give that rope a good dose of lubricant if you want to save it."

Yours, Al

BY keeping your wire ropes properly lubricated, you save money two ways: You protect the rope from premature failure; and you reduce friction.

Proper lubrication is an effective deterrent to corrosion. It protects both inside and outside wires against destructive rusting. It keeps all wires free to slide over each other, as they must do when the rope bends over sheaves and drums. It minimizes friction and wear between individual wires, and between the rope and sheaves or guides through which it passes. It is the safest, surest method of preventing excessive wear inside the rope, where you can't see it.

See that all wire ropes are properly lubricated at regular intervals. Insure greater safety—prolong rope life—reduce lost time—get the benefits of fewer replacements. For specific recommendations on wire rope lubricants and lubrication practice, see the Tiger Brand Wire Rope Engineer who contacts you.

AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York
COLUMBIA STEEL COMPANY
San Francisco
United States Steel Export Company, New York

UNITED STATES STEEL

TABLE II

Silty Clay

Water Per cent by wt.	Water Per cent by Vol.	Per cent of P. L.	Aggregate Wt. per cu. ft. dry-lb.	Aggregate Per cent by vol.	Air Voids Per cent	Load-bearing Value Lb./sq. in.
40.8	50.3	144	83.0	49.7	0.0	38
37.0	49.5	131	86.0	51.5	0.0	40
33.3	47.4	117	89.0	53.0	0.0	42
30.0	44.2	106	92.0	55.7	0.1	44
28.5	43.1	101	93.7	56.6	0.3	68
26.1	41.2	92	98.1	58.5	0.3	100
24.2	38.7	86	99.8	59.7	1.6	127
23.5	37.4	83	99.4		3.2	

At optimum density the dry weight is 99.8 lb. per cu. ft. and the water content is 24.2 per cent

25.6	39.6	125	96.5	59.0	1.4	25
22.0	35.6	107	101.6	62.2	2.2	42
19.8	33.4	96	106.5	65.1	1.5	90
19.0	33.0	93	107.9	66.0	1.0	140
18.3	32.2	89	109.4	66.9	0.9	200
17.0	29.1	83	107.3	65.6	5.3	

At optimum density the dry weight is 110.0 lb. per cu. ft. and the water content is 18.0 per cent

SOIL NO. 1

19.4	32.9	123	105.7	64.1	3.0	11
18.5	32.2	117	108.4	65.9	1.9	20
16.7	30.4	106	113.1	68.7	0.9	38
15.5	28.8	98	116.1	70.4	0.8	62
13.6	26.4	86	120.5	73.0	0.6	193
12.4	24.0	78	121.0	74.0	2.0	250
11.1	23.8	70	120.1	72.9	3.3	300

At optimum density the dry weight is 121 lb. per cu. ft. and the water content is 12.4 pr cent

SOIL NO. 2

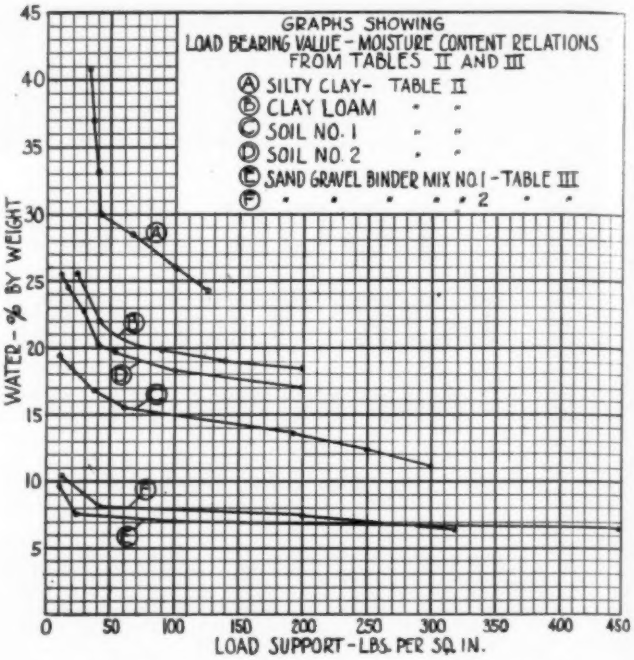
25.5	39.3	127	96.2	59.0	1.7	13
24.5	38.8	122	98.6	60.5	0.7	18
22.7	37.2	113	102.5	62.9	0.0	30
20.3	35.7	101	105.6	64.8	0.0	41
19.6	33.8	98	107.4	65.9	0.3	55
18.3	32.3	91	110.0	67.5	0.2	100
17.0	30.1	85	111.0	68.1	1.8	200
16.5	28.9	82	109.1	67.0	4.1	

The water is expressed as a percentage of dry weights.

The values in the third column are obtained by dividing the percentage of water used (by weight) by the plastic limit of the sample and multiplying by 100.

24 hours, but due to loss of water during freezing, we always obtained contraction instead of expansion. However, by letting the frozen samples thaw and come to constant weight in air we were able to get a figure which represents increase in volume due to freezing. As an example, the silty clay showed a shrinkage of 5.8 per cent after drying and 4.8 per cent after freezing and drying. The difference of 1 per cent is volume increase due to freezing. The results on this series of tests are shown in Table I.

The effect of water by capillarity was determined by leaving the specimen in the mold, attaching a perforated steel plate to the bottom of the mold and immersing the mold in water so that the water level was at the bottom of the soil samples. The samples were left in water for a period of 7 days at the end of which absorbed water was determined by weight and any increase in volume noted at the top of the mold. None of the samples packed at optimum showed any absorption by weight or increase in volume. Samples which were packed at optimum and allowed to lose about half of their water content and then submitted to capillarity in no case took up more



Load Bearing Value—Moisture Content Relations

water than they contained at the time of compaction. Samples which were packed with approximately 5 per cent voids, when submitted to capillarity took up enough water to reduce the voids to about 3 per cent and then stopped. No volume increase was noted in any of these experiments.

Selection of Soils for Sub-Base

The information obtained in the laboratory was used to determine the load bearing value of the undisturbed sub-grade and the selection of the most suitable soils for fills and sub-base work. To determine the load bearing value of the sub-grade, density tests were made on the sub-grade soils at a depth 12 in. below the top of the sub-grade. From density tests the water capacity of the soils was calculated. From the water capacity and water-load-bearing-value curves the load bearing value of the soils was determined as follows:

The silty clay has a natural dry weight of 83 lb. per cu. ft. and a water capacity of 40.8 per cent by weight, which corresponds to a load bearing value of 38 lb. per sq. in. (on Curve A, which presents laboratory data on the same soil.) The clay loam has a natural dry weight of 99 lb. per cu. ft. and a water capacity of 23.75 per cent by weight. Its load bearing value is 33 lb. per sq. in. (from Curve B). The fine sand has a natural dry weight of 102 lb. per cu. ft. and a moisture content of 9.3 per cent by weight. In the laboratory we were able to get a dry weight of 96 lb. per cu. ft. at a moisture content of 23 per cent by displacing water in a mold with a porous bottom. This material when wet has a bearing value of 333 lb. per sq. in. From these tests we concluded that the bearing value of the sub-grade at its weakest spot at saturation is 33 lb. per sq. in.

For the construction of the sub-base and fills all the soils in Table I were available. From the standpoint of load bearing capacity, all are satisfactory if properly compacted. However, the silty clay is hard to handle, due to its stickiness when wet and toughness when dry. Furthermore, it is susceptible to high volume changes and requires high compactive loads to densify it. The clay loam handles fairly easily but its susceptibility to volume changes is high. The fine sand can not be packed

except by some hydraulic method. On the other hand, Soils No. 1 and No. 2 are very desirable in all respects and for that reason were used wherever possible.

Base and Sub-base Thicknesses.—As a result of all tests and experiments the following thicknesses were selected for the N.E.-S.W. and the N.-S. runways which were constructed in 1936 and 1937:

Sub-Grade P. I.	Sub-Base Thickness	Base Thickness
30 or less	6 in.	5 in.
30 to 40	4 in.	8 in.
Over 40	4 in.	10 in.

In addition to varying the thicknesses in accordance with the plasticity index whenever sand was to be the sub-grade, 6 in. of sub-base and 5 in. of base were used. All of the base was to be covered with 2 in. of coarse asphaltic concrete which in turn was to be covered with 1 in. of stone filled sheet asphalt pavement.

The Base

Because they were available economically it was decided before hand to use either plaster sand or sand-gravel, with a suitable binder soil, for the base course. The plaster sand available had the following grading:

Retained on the No. 10 sieve—3 per cent; on the No. 40—60 percent; on the No. 80—98 percent; on the No. 100—99 percent.

The sand-gravel had the following grading:

Passing the ⅜ in. sieve—100 percent; passing the No. 4 sieve—85 percent; passing the No. 10 sieve—50 percent; passing the No. 40—10 percent; passing the No. 100—1 percent. Both materials have a specific gravity of 2.60.

Both of these materials were mixed with soils so that the portion of the total mixture which passed a No. 40 had P. I.s of from 10-30. All mixtures were graded for maximum density. The same tests as shown for the soils in Table II were conducted on these mixtures.

In general it was learned that:

(1) The weight per cu. ft. of the compacted mixtures increases as the maximum sizes of the aggregate increases.

(2) That the water capacity of the mixtures decreases as the maximum size of the aggregate increases, as the P.I. of the binder decreases, and as the percentage of material passing the No. 40 decreases.

(3) The load bearing value increases as the water content decreases.

(4) The susceptibility to volume changes decreases as the water content at optimum decreases.

(5) While it is desirable to use low P.I. binders and a minimum amount of them, with these mixtures proper compaction can not be obtained when the P.I. is much less than 15 or when the amount of binder passing the No. 40 sieve is less than about 25 percent of the mixture.

After considering all of the factors entering into the construction of the base it was finally decided to use sand-gravel and a binder which would produce a P.I. of about 15 or 20. Since it was known in advance that the P.I. of the binder in the sand-gravel mixtures could not be controlled within very narrow limits a series of tests were made in which this P.I. was varied from 16 to 29. These tests are shown in Table III. It will be observed that the water content varies only 1 percent between these two mixtures and that the other characteristics are practically the same for both mixtures. Attention should be called also to the fact that the mixture finally selected for the base has very low lineal shrinkage on drying and no expansion on freezing.

TABLE III

Sand Gravel-Binder Mixtures

Mixture No. 1

27 per cent Soil No. 1; 73 per cent Sand-Gravel, material passing No. 40 same characteristics as Soil No. 1, Table II. Shrinkage due to drying 0.2 per cent. Expansion due to freezing—none.

Water Per cent by wt.	Water Per cent by vol.	Aggregate Wt. per cu. ft. dry	Aggregate Per cent by vol.	Per cent Air Voids	Load-bearing Value Lb./sq. in.
9.6	20.0	129.3	79.3	0.7	12
7.5	16.2	134.1	82.3	1.5	25
7.0	15.2	136.0	83.4	1.4	100
6.4	13.9	135.5	83.0	3.0	450
6.0	13.0	133.9	82.2	4.8	610

Mixture No. 2

27 per cent Soil No. 2; 73 per cent Sand-Gravel, material passing No. 40 same characteristics as Soil No. 2, Table II. Shrinkage due to drying 0.3 per cent. Expansion due to freezing—none.

Water Per cent by wt.	Water Per cent by vol.	Aggregate Wt. per cu. ft. dry	Aggregate Per cent by vol.	Per cent Air Voids	Load-bearing Value Lb./sq. in.
10.4	21.3	127.0	77.8	0.9	13
8.1	17.2	132.3	81.2	1.6	42
7.4	16.1	134.7	82.7	1.2	200
6.4	13.7	133.5	81.9	4.5	320

Construction Procedure.—Before actual construction was started approximately 4 in. was removed from the areas on which the runways were to be built. This process removed all the vegetation and most of the roots. The next step consisted of removing undesirable materials, and making fills with materials having P.I.s' of 15 to 25. All fills below 12 in. from the top of the pavement were compacted to 95 percent optimum density and all soils between the top of the sub-grade and the bottom of the base were compacted to at least 97 percent of optimum density. No material was packed in layers greater than 6 in. All compaction was done with sheeps-foot rollers having 150 to 200 lb. weight per sq. in. on the face of the feet.

The sand gravel-binder course was next constructed. All 5 in. layers were packed in one course. Layers greater than 5 in. in thickness were packed in two courses. The same rollers used on the sub-base were used on the base. The P.I. of the mixtures actually used varied from 16 to 23 and the percentage of material passing the No. 40 varied from 20 to 33 with an average of approximately 25. The mechanical analysis of a typical mixture follows:

Total clay, 5 percent; passing the No. 200 sieve, 18 percent; passing the No. 4 sieve, 25 percent; passing the No. 10 sieve, 75 percent; passing the No. 4 sieve, 85 percent; and passing the ⅜ in. screen, 100 percent. All base work was compacted to at least 97 percent of optimum density and most of it was packed to 100 percent optimum density. On the average the compacted mixtures contained 6 to 7 percent water and had a dry weight of 135 lb. per cu. ft.

The following is a brief outline of the methods used in controlling the compaction processes: the sub-base soils were mixed with water so that about 2 percent more than the optimum requirement would be present. Rolling was then started and continued until the roller feet rode on top. In constructing the base the sand gravel and binder soil (all smaller than 1 in.) were spread upon the sub-base, one on top of the other and thoroughly mixed by means of harrows and discs. About one-half of the required water was added and the materials mixed by blading to the sides and back again. After levelling the balance of the water was added and the mixing process repeated. Before rolling was begun about 2 percent excess water was added and a few passes of the roller made. The materials were now

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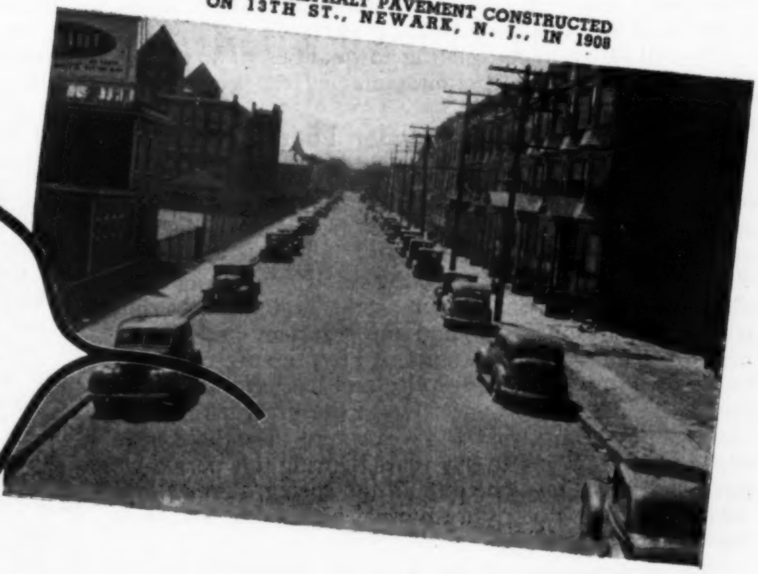

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allowed to dry until the water content was slightly above optimum and rolling begun and carried on as described under sub-base. At the end of the rolling it was usually necessary to add water to replace evaporation loss. This compaction process usually produced desired density. Practice had shown that if over wetting was not done false packing would sometimes result, that is the material appeared to be dense but was not. Furthermore, over wetting is necessary to produce intimate mixing of the binder soil and aggregate. On the average it required 20 passes for 6 in. layers to produce the densities given.

After compaction of the base was completed the surface was fine graded by hand and was then ready for the bituminous courses. The coarse layer of the bituminous pavement consisted of a well graded mixture with 1½ in. maximum size. The mixture was rather rich in asphaltic cement but was fairly open on top to provide a good bond between it and the finely graded asphaltic concrete wearing surface. The wearing surface was a stone filled sheet asphalt rather high in asphaltic cement to provide good water resistance and self-healing qualities. The asphaltic cement used in both courses had a penetration of about 150 at 77 deg. F. It had a ductility of at least 60 at 41 degs. F. and of at least 100 at 60 degs. F. All bituminous pavement was laid by the hot plant-mix method.

1938 Program

In 1938 the N.W.-S.E. runway was constructed. As a result of observations on the construction and performance of the other two runways the following modifications were made on the type of construction:

(1) A 6 in. sub-base and a 5 in. base were used on all areas regardless of sub-grade material.

(2) The bituminous slab was cut to 2 in.; 1½ in. of asphaltic concrete (1 in. maximum size) and ½ in. of stone filled sheet asphalt wearing surface.

(3) All other items relating to qualities of materials and methods of construction remained the same.

Performance Under Loads

In 1936 when construction of the runways was contemplated the largest plane, the DC 2, using the Omaha airport had a wheel load of 9,200 lb. and its tires had an equivalent circle diameter of 17 in. inflated to about 40 lb. per sq. in. Shortly after the firts runway was completed the DC 3 plane, known as the Mainliner, having wheel loads of 13,500 lb., and an equivalent circle diameter of 18 in. in its tires and an air pressure of 51 lb. per sq. in. was placed in service and has been using the Omaha runways ever since. Up to the present time one runway has been in use 3½ years and the others have been in use from 1½ to 2½ years. During this period we have had normal wet periods in the spring, normal cold weather in the winter, and normal high water stages in the Missouri River.

The performance of the runways under the above loads up to April 1, 1940, can be summarized as follows:

(1) No evidence of sub-grade, sub-base, or base failure has been noticed at any time, that is, no settlement, heaving, sponginess, or shoving has occurred.

(2) There are no transverse or longitudinal cracks although one of the runways is 4,500 ft. long.

(3) In extremely hot weather the bituminous wearing course becomes quite soft and pliable as a result of which the plane tires mark it up. When the planes turn around sharply the tires do a slight amount of tearing which later heals up.

(4) There are no signs of surface wear or disintegration.

Characteristics of Sub-base and Base After One Year's Actual Use.—In May, 1937, about one year after the first runway was built, a number of test holes were made along the sides of this runway which showed that the water level came within 3 ft. of the top of the pavement when the river was at its highest. At about the same time and again in November, 1937, several density and moisture tests were made on the base of this runway. The dry weight per cubic foot was approximately the same as when laid and the moisture contents were as follows: 6.8 percent, 9.8 percent, 5.5 percent, 4.5 percent, 6.8 percent, 7.1 percent. As stated before the percentage of water at optimum on this base mixture should be approximately 7 percent. It will be observed that all field samples tested were at optimum or below except one. The high water content on this one sample can be explained by the fact that occasionally the binder soil did not become thoroughly disintegrated in the process of mixing. Similar tests made on the compacted sub-base showed that the density did not decrease and that the water content did not increase.

Theoretical Considerations

As has already been stated the runways have been carrying wheel loads of 13,500 lb. When a 50 percent impact is added these loads become about 20,000 lb. By using the tire data given for the Mainliner and the formula proposed by Prof. W. S. Downs, $T = 0.564 W/S$ (T = thickness of pavement required, W = wheel load, S = load bearing value of sub-grade) a thickness of 14.5 inches is required if the load bearing value of the sub-grade is 30 lb. per sq. in. and 20.5 in. if the load bearing value of the sub-grade is 15 lb. The minimum thickness of the runway pavement is 7 in. and the safe load bearing value of the sub-grade is about 15 lb. per sq. in. (50 percent of value determined by us.) According to this formula the runways should fail under the loads being imposed upon them. Even if we assume that the 6 in. of compacted soils act as pavement the total thickness of the runways is still only 13 in., and according to the formula they should fail.

Mr. B. E. Gray suggests a modification of the Downs' formula by subtracting from the calculated required thickness the radius of the equivalent tire circle. Making this modification the required thickness in the above example becomes 5.5 in. if the sub-grade support is 30 lb. per sq. in. and 11 in. if the sub-grade support is 15 lb. per sq. in. If we assume that the compacted soils have a distributive power equal to one-half that of the base the total pavement thickness becomes 10 in., that is, 2 in. of bituminous pavement, 5 in. of base, and 3 in. compacted soil base. As stated previously if the compacted soil has the same distributive power as the base the total thickness of pavement becomes 13 in.

Judging from the behaviour of the runways it is evident that the Downs' formula is too conservative. The Gray formula more nearly fits the field performance if the compacted soils are considered as pavement.

The load bearing value test was used primarily to obtain information on the sub-grade. However, this test is also of value in pre-determining the degree of compaction necessary to prevent flow in compacted aggregate-soil mixtures under given loads and for this reason it becomes of prime importance in soil stabilization work.

A test which reveals the beam strength of compacted soils, as the P.I. varies, was also used. This test was made by compacting 1½ in. of the soil in a mold 8 in. in diameter by 4 in. in depth, applying load through a 2 in. diameter bearing block at the center of the radi-

ally supported span, and noting the maximum load supported. Some of the results were as follows:

At optimum density the silty clay supported 230 lb.; the clay loam, 120 lb.; and a soil using P.I. of 10, 50 lb. These tests show very definitely that the beam strength decreases rapidly as the P.I. decreases.

Resume of Observations

The following conclusions may be drawn from the laboratory and field observations made in connection with this project:

(1) Clay bound soil mixtures may be densified to support definite loads.

(2) Properly graded and compacted soil mixtures will not take up more water by capillarity than is used in compaction.

(3) Clay bound soil mixtures can be so designed and compacted as to show no detrimental volume increase on freezing and no volume decrease on drying.

(4) Clay bound soil mixtures produce only hair checks on drying rather than cracks at regular intervals.

(5) Finally, it appears that road beds may be constructed with clay bound bases and sub-bases which will be truly stable in that they will support definite loads under all conditions.

Personnel

The Omaha air port runways were designed by Mr. Roy M. Green of the Western Laboratories, Lincoln, Nebraska, and Mr. W. H. Campen of the Omaha Testing Laboratories, Omaha, Nebraska.

SHEAR TESTING OF SOILS

An important feature of the 1939 annual meeting of the American Society for Testing Materials was a symposium on shear testing of soils. The eight technical papers, by outstanding authorities, presented at this symposium have been published in a 128-page book, copies of which can be obtained from the headquarters of the society, 260 South Broad St., Philadelphia, Pa., for $1.25 each.

Topics covered in the papers include torsion shear tests and their place in the determination of the shearing resistance of soils; practical aspects of shear testing; essential features of triaxial tests; description of the triaxial compression apparatus for the determination of stress-deformation characteristics of soils; and a comparison of results of direct shear and cylindrical compression tests. There are also papers on shearing resistance of cohesionless and cohesive materials; the measurement and practical significance of shearing resistance; and the effects of internal hydrostatic pressure on shearing strength.

Asphalt in Railroad Ballast Construction—An interesting new use of asphalt is being developed in railroad ballast construction J. J. Pelley, president of the American Association of Railroads, recently announced the initial experiment of the New York Central System, tried on a 600-ft. stretch of track near Bryan, O. In this the asphalt-crushed rock mixture is placed between and beneath the ties and sloped downwards from each side of the tracks to provide drainage.

RECTANGULAR COORDINATE GRAPH METHOD USED TO

Design Aggregate—Soil Mixtures For Stabilized Road Surfaces

By HERBERT E. WORLEY

Assistant Engineer, Kansas State Highway Commission

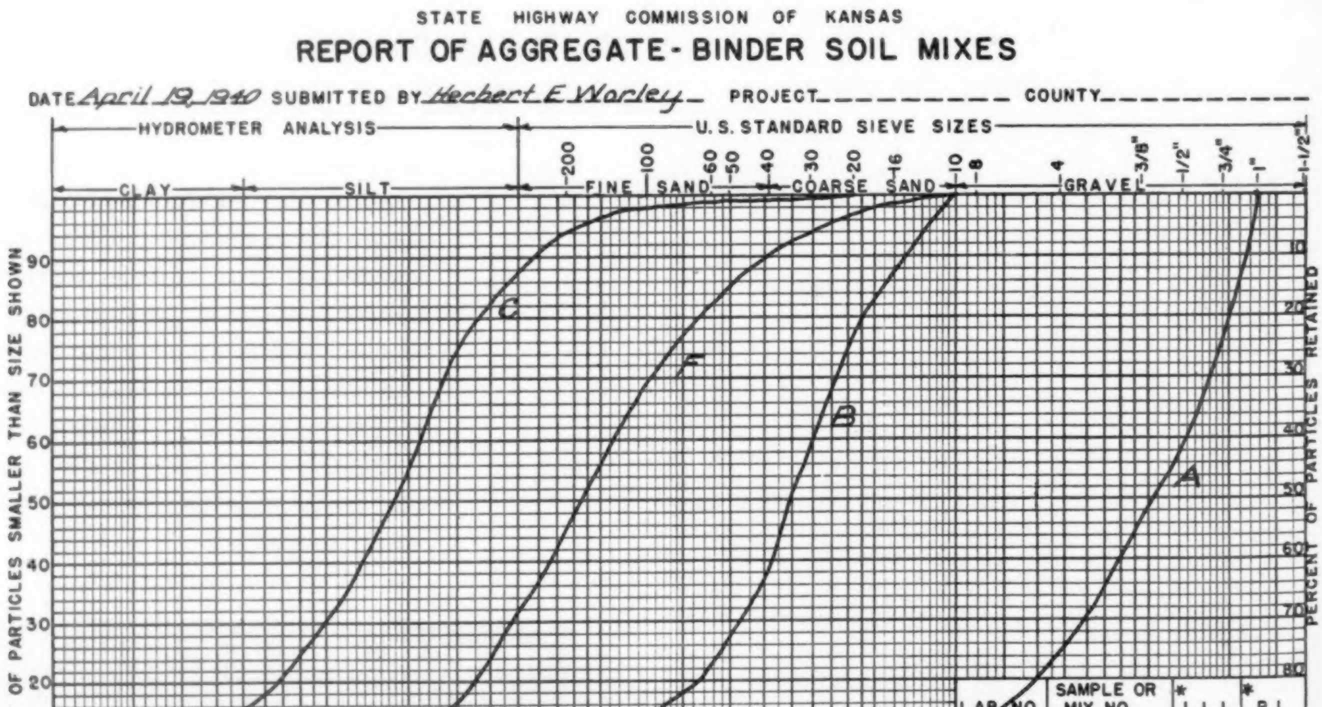
COMBINING materials from different sources often proves advisable and/or economical in preparing soils for stabilized road construction. The problem of determining proper proportions of each barrow pit or source of supply may be determined by the triangular coordinate chart, or by the rectangular coordinate graph method explained herewith. The writer has done considerable work on stabilized soil mixes during the last year and a half. He has developed the rectangular coordinate graph method, which is probably simpler to explain and to use than the triangular coordinate chart. A number of materials may be combined by either method. An example of the rectangular graph method is given.

Design of Stabilized Mixes

A mix may be designed to meet gradation specifications very readily by means of a rectangular coordinate graph. The percentage retained on No. 10 sieve may be plotted as ordinate and the percentage passing No. 200 sieve as abscissa. Each material and the specification limit or limits within which the mix is desired may be drawn on the graph.

The specifications for this example are as follows:

Sieve	% *Retained*
1 inch	0
¾ inch	0-25
No. 4	40-60
No. 10	50-70
No. 40	65-80
No. 200	80-92



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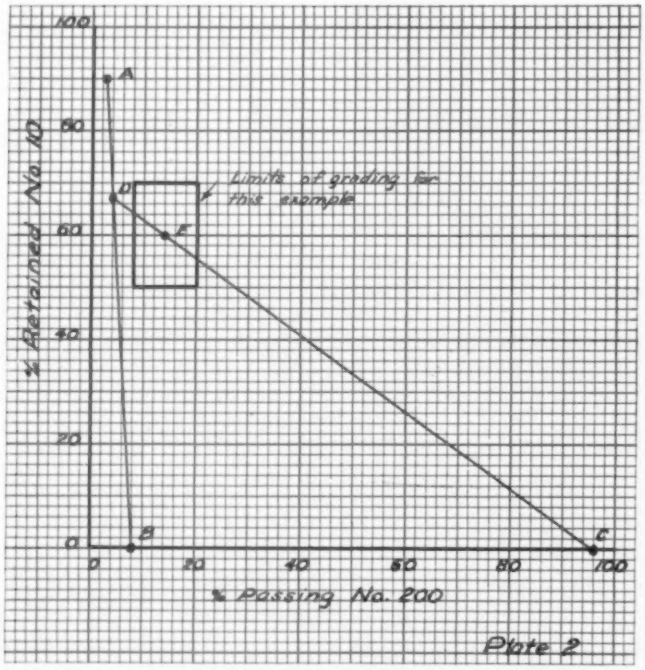


P. I. 3 to 8; LLL not over 30. The fraction passing the No. 200 sieve shall be not greater than two-thirds (2/3) of the fraction passing the No. 40 sieve.

The test results of the materials are given in the following table:

TABLE NO. 1

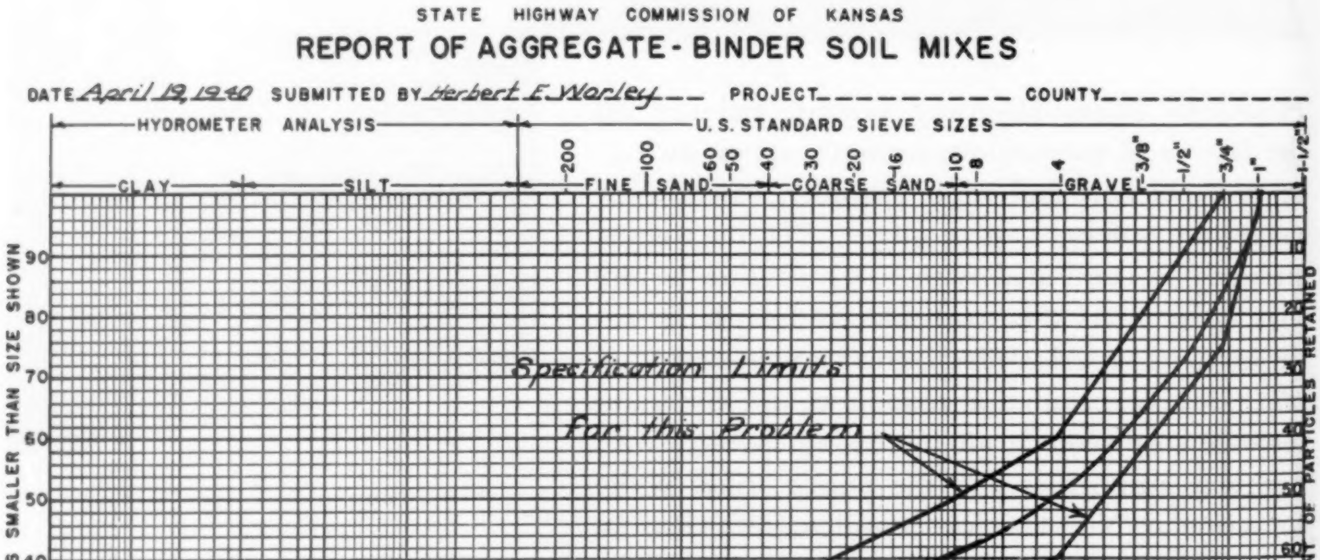
Materials	*Percent Retained on Sieves*										*mm. size*		
	1	¾	⅜	4	10	20	40	60	100	200	02	001	P.I.
Agg. No. 1......	0	25	54	76	90	92	94	95	96	97	100	100	6
Agg. No. 2......					0	24	60	77	86	92	97	99	1
Agg. No. 3......					0	3	11	18	30	54	90	98	2
Binder Soil						0	1	1	2	4	43	94	9

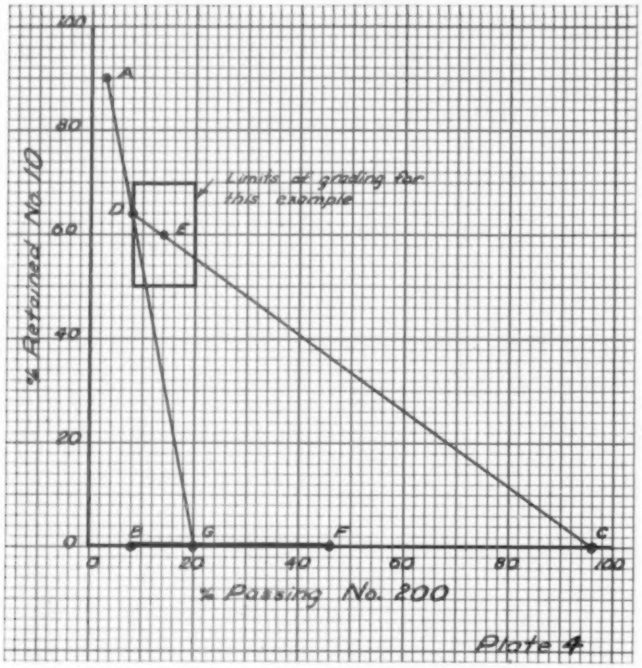
These materials are also shown on Plate 1.

Three Material Mix.—Three materials usually may be combined to form a satisfactory mix. Using the materials in Table No. 1, plot (see Plate 2) aggregate No. 1 at A (90 per cent retained on No. 10, 3 per cent passing No. 200). Then plot aggregate No. 2 at B, and binder soil at C. Draw the line AB. Any point on this line represents a combination of aggregate No. 1 and aggregate No. 2. Select a point E within the specifications and draw a line from C through E to where it intersects the line AB. Mark this intersection D. Another procedure is to draw the line CD giving attention to its position through the specifications or to the position of D on the line AB. The point E must then be selected on the line CD. A study of the grading curves of the individual materials (Plate 1) is helpful in determining the proper position of D and E to obtain a smooth curve or desired plasticity index if this can not be done by taking E in the center of the specifications.

The ratio of DE to DC gives the percentage of C in the mix.

Note: Ratio of distances are taken from projection of lines either on abscissa or ordinate.





$\frac{DE}{DC} = \frac{10}{92} = 11\%$ C or Binder Soil

This leaves $100\% - 11\% = 89\%$ (A+B)

$\frac{AD}{AB} = \frac{23}{90} = 25.6\%$ of (A+B) is B

$25.6\% \times 89\% = 23\%$ B or Agg. No. 2

$100\% - 25.6 = 74.4\%$ of (A+B) is A

$74.4\% \times 89 = 66\%$ A or Agg. No. 1

The mix is then—

66% Agg. No. 1
23% Agg. No. 2
11% Binder Soil

100%

The gradation may be calculated by taking 66 per cent of the percentage retained on each sieve of aggregate No. 1 as given in Table 1, 23 per cent of the percentage retained on each sieve of aggregate No. 2, 11 per cent of the percentage retained on each sieve of binder soil, and taking the total of the percentages retained on each sieve.

TABLE II

Percent of Materials	1	¾	⅜	4	10	20	40	60	100	200	.02 mm. size	.001 mm. size
66% Agg. No. 1	0	16	36	50	59	61	62	63	63	64	66	66
23% Agg. No. 2					0	6	14	18	20	21	22	23
11% Binder Soil									0	0	5	10
Gradation of Mix	0	16	36	50	59	67	76	81	83	85	93	99

This gives the gradation shown in Table II.

This gradation of mix may be plotted on Plate 3.

The plasticity index may be calculated as follows:

TABLE III

Materials	A Proportions of Materials Used	B Percent of Materials Passing the No. 40 Sieve	C $A \times B$	D Plasticity Index of Materials	E $C \times D$	F P. I. of Mix Total $E \div C$
Agg. No. 1	66 percent	6	4.0	6	24	
Agg. No. 2	23 percent	40	9.2	1	9	
Binder Soil	11 percent	99	10.9	9	98	
Totals	100 percent		25.1		131	5

Four Material Mix.—Sometimes a satisfactory mix cannot be made from any three materials located, and four materials are required. The rectangular coordinate graph may be used for designing a mix with any number of materials, although the process becomes more complicated and more trials may be necessary as more materials are used. The addition of aggregate No. 3 slightly improves the mix calculated with three materials. The gradation is given in Table No. 1 and plotted on Plate No. 1. All four materials may be plotted on the rectangular coordinate graph as on Plate 4. Draw the line BF. Select the point G. Inspection of Plate 1 indicates that G should be nearer B than F. This point may be selected at not the best position the first time, as shown by total gradation or P.I. of the mix, and other trials may be necessary, but although this is done, the mix is at the same time controlled at the two major points—the No. 10 and No. 200 sieve sizes. Draw the line AG. Select the point E within the specifications, or the point D on the line AG, and draw the line CD.

The ratio of DE to DC gives the percentage of C in the mix.

$\frac{DE}{DC} = \frac{6}{88} = 7\%$ C or Binder Soil

This leaves $100\% - 7\% = 93\%$ (A+B+F)

$\frac{DG}{AG} = \frac{64}{90} = 71\%$ of (A+B+F) is A

$71\% \times 93\% = 66\%$ A or Agg. No. 1

$\frac{AD}{AG} = \frac{26}{90} = 29\%$ of (A+B+F) is (B+F)

$29\% \times 93\% = 27\%$ (B+F)

$\frac{BG}{BF} = \frac{12}{38} = 31.6$ of (B+F) is F

$31.6\% \times 27\% = 9\%$ F or Agg. No. 3

$100\% - 31.6\% = 68.4\%$ of (B+F) is B

$68.4\% \times 27\% = 18\%$ B or Agg. No. 2

The mix is then—

66% Agg. No. 1
18% Agg. No. 2
9% Agg. No. 3
7% Binder Soil

100%

The gradation and P.I. may be calculated by the same method as shown for the three-material mix.

TABLE IV

Percent of Materials	1	¾	⅜	4	10	20	40	60	100	200	.02 mm. size	.001 mm. size
66% Agg. No. 1	0	16	36	50	59	61	62	63	63	64	66	66
18% Agg. No. 2						4	11	14	15	17	17	18
9% Agg. No. 3							1	2	3	5	8	9
7% Binder Soil											3	7
Gradation of Mix	0	16	36	50	59	65	74	79	81	86	90	100

The gradation of mix may be plotted on Plate 3.

The P.I. calculations are as follows:

TABLE V

Materials	A Proportions of Materials Used	B Percent of Materials Passing the No. 40 Sieve	C $A \times B$ / 100	D Plasticity Index of Materials	E $C \times D$	F P. I. of Total $E \div C$
Agg. No. 1	66 percent	6	4.0	6	24	
Agg. No. 2	18 percent	40	7.2	1	7	
Agg. No. 3	9 percent	89	8.0	2	16	
Binder Soil	7 percent	99	6.9	9	62	
Totals	100 percent		26.1		109	4

If the gradation or P.I. is not satisfactory, another trial may be made.

A study of the materials may indicate the changes that are necessary.

BRIDGE FOUNDATION FAILURES

By RUSSELL BORHEK

AT the present time there appears to be no systematic method of reporting bridge foundation failures, determining the cause of failure or checking the depth of erosion, despite the fact that every flood takes its toll of bridges. Usually, where an examination of the washout has been made, very little worthwhile information can be obtained from such reports, because the report is based, largely on superficial observation and not on carefully determined or measured facts.

Hydraulic research has not advanced, at least in this country, to a point where foundation failures are tested and measured and the cause of erosion and scour determined. As far as known, no data are available to measure the scouring effect of currents at high velocities or the maximum bed velocities consistent with stability; nor are researches available to determine the economy of rip-rap or the best form of bed protection against erosion. An examination of public records indicates that there is little if any information available that can be used as a basis for the safe design of bridge foundations under the variable conditions met in actual practice (every foundation is a problem of its own) and the indiscriminate use of bridge waterway formulae has led to many insecure if not dangerous foundation designs.

Railway Committee Report

Stimulated by the loss of numerous railway bridges during 1934-35, a committee of the American Railway Bridge and Building Association submitted questionaires to 36 roads, controlling 220,000 miles of track in the United States and Canada, and at the annual convention of the Association, Oct. 1935, presented answers from 30 roads that had replied. This inquiry was for the purpose of securing information on railway bridge foundations and their underwater inspection.

Of the 30 roads that replied it was found that 20 of them made annual or semi-annual inspections and that 10 roads made soundings twice a year, also soundings after every severe flood and that the extent of the soundings varied considerably. Only a few of the roads had complete or accurate knowledge of their foundations (as built). The majority of the roads had plans for bridges built only during the past 25 years; but for older structures no plans were available. Only two roads had complete records of their bridge foundations while many of the roads had no idea of what the foundations were like beneath the rivers bed.

In the discussion that followed the presentation of the data, stress was placed on the importance of ascertaining the true condition of the foundations of all structures where no plans were available. As a result several of the roads have increased their efforts in underwater inspections by using divers where the water is deep enough to warrant thorough inspection. It was the consensus of opinion that accurate measurements for erosion should be made up and down stream from the bridge, at least 200 ft. or more if conditions required. It was also the opinion that in many cases of failure due to floods or other unusual conditions, the failure could not have been averted by any programme of inspection and that there were only a few cases on record where foundations had failed as the result of scour over a long period of time, for such scour is usually detected during periodic bridge inspection and protective measures are taken. Failures due to not keeping the waterway free from drift or other accumulations that block the normal course of water and undermine foundations were not uncommon.

In this connection it would be only fair to state that many bridge waterway openings were designed by the use of Dunn's Tables, assuming a mean velocity of 10 ft. per second, then considered ample to meet any flood flow. Subsequent developments, greater floods than ever before recorded with correspondingly higher run off, brought about by a complication of circumstances, cleared land, channel silting, bank encroachments, etc., have caused a revision of thought regarding maximum flood velocities; in fact mean velocities of 15 to 25 ft. per second are not uncommon today. These extreme velocities have generally been caused by cloudburst floods and have caused hundreds of bridge washouts during the past ten years.

Washouts Due to Cloudburst Floods

The scouring or erosive effects of cloud burst floods is evidenced by the bridge washouts enumerated below. In the table the bed velocity is taken at .60 per cent of the mean velocity at or near the bridge opening.

Name of Stream	Kind of Bed	Amount of Erosion per foot rise	Approximate Bed Velocity Ft. per Sec.	Depth of Erosion Ft.
Verde River	Sand, Silt	2	4	10
Devils Creek	Sand, Loam	1.8	4.2	32
Cole Creek	Sand, Clay	1.5	8.0	11
Purgetory Creek	Gravel, Cobble	1.0	11.4	17
Custer Creek	Gravel, Clay	0.7	8.0	12
Blue Water Creek	Hard Clay	0.5	11.0	12
Starland	Clay	0.75	—	11
Anacosta Creek	Mud, Sand, Gravel	—	—	12
Miami	Clay, Gravel	—	10.0	7
Stillwater Creek	Gravel, Rock	—	12.0	17

Investigation by the Interstate Commerce Commission Bureau of Safety, disclosed the fact that in the cases of Cole Creek, Wyoming, Custer Creek, Montana, Blue Water Creek, New Mexico and Anacosta Creek, District of Columbia, no inspections of the foundations had been made for some time prior to the washouts and that progressive erosion had been apparent for some time prior to the failures. In two instances rip-rap had been used, nevertheless failure had occurred. In the case of the Anacosta Creek washout erosion had been noted a long time before the failure and this condition had been intensified by dredging below the bridge.

During recent floods in Colorado, New York and California, extreme bed velocities were noted and the rolling and dragging movement of boulders along the bed was quite audible to one stationed along the bank.

In floods of the cloudburst type, the flood wave advances with great rapidity gathering up debris of all kinds causing considerable erosion, often with only a moderate rise in the water level. This is particularly true for streams having a rapid fall where the erosive and transporting power increases tremendously with an increase in velocity. This is reflected by the sixth power law; that is, the weight or volume of particles that can be moved by a stream varies with the sixth power of the velocity.

It has been found that the resistance of a material to scour increases as the water deepens and that bed materials differ widely in their power to resist scour and that the scouring (or erosive) forces take different forms, such as planing off, channelling or eating away the bed, causing the bed to deepen or recede. Drift accumulations will channel out or undermine piers or abutments; these are common forms of damage. Water escaping from beneath loosely piled rip-rap will undermine foundations; the same effect is caused by water escaping beneath drift.

It has been observed that, during a flood, where drift material was obstructed by piling, piers or abutments, etc., in "breaking away" and passing through the opening, the drift will submerge, drag along the bottom and when free of the opening, will rise to the surface and pass on down stream. It can well be imagined what damage might be done to an erodable bed.

In order to take care of extreme floods many bridges are built above the grade of approach fills with a view of allowing the fill to wash out; whether or not this is good practice is debatable.

River Bed Protection

Many efforts have been made to maintain a river bed, usually by the use of rip-rap, which, unless used in quantity and carefully placed, will not assure ample protection. The best form of rip-rap is hand placed stone of large size, close jointed, flat bedded with smooth, regular faces exposed to currents, all of which should be placed below the bed to assure ample waterway opening. Even with this form of protection the stone should protect the bed above, beneath and below the structure.

In the light of present knowledge, waterway openings need not be designed primarily to reduce flood velocity below the limits of scour, as the bed can be protected to resist velocities considerably above the assumed safe limits of scour. Such protection can be accomplished by the use of a flexible wire mat (mesh), placed on the bed and well anchored in the bed above the bridge and extending through the opening to a point below the bridge. This will prevent drift, logs, ice, etc., from channelling or digging out the bed. The reason for this is: once transportation of debris begins, the impact of the water causes the bed material to roll, slide, or skip along the bottom, where the particles tend to override one another and are obstructed by the meshes of the mat. The meshes not only prevent travel of the particles, but cause an interlocking, which in turn "jam up" and prevent erosion. Bed velocities of 15 ft. per second can be resisted by this means where the bed materials are composed of gravel and coarse aggregate.

The velocity at or near the bed is very difficult to determine but usually will be from .60 to .70 per cent of the mean velocity.

The effectiveness of this means can readily be determined by simple experiment using a flume with sufficient slope and hydraulic radius.

LIGHT FOR PREVENTING COLLISIONS WITH CENTER ISLANDS

An obstacle light which has proved effective in preventing automobiles from striking the ends of center islands in divided highways has been placed in service on the highways of Wayne County, Michigan.

Some trouble had been experienced with automobiles striking the ends of these islands at points of transition from single to double pavement. The trouble has been eliminated entirely where these lights have been installed.

The light was designed by engineers of the Board of County Road Commissioners. It is constructed with a short piece of 4-in. iron pipe in which a light socket is fastened. One end is fitted with a standard pipe cap which has the center cut out and replaced with an amber-colored glass lense. The pipe is laid on top of the curb, or just back of the curb where the island is of concrete, with the front end tilted up slightly. The back end of the pipe can be covered with another cap into which the conduit is fitted, or can be screwed into an elbow which can be set in concrete to hold the lamp in place. A 67-watt traffic signal bulb is used. The light is very cheap to construct, install and maintain. It is weather-proof and is kept free from ice and snow by the heat of the lamp.

STEAM CLEANING MACHINE IN BRIDGE MAINTENANCE

A portable steam cleaning unit is used for cleaning accessible surfaces of the San Francisco-Oakland Bay Bridge prior to painting. This equipment is similar to, and probably more familiar as, the steam cleaning machine used in garages and other industrial plants for cleaning greases, oils, etc., from car chassis and engines. It is essentially a boiler with a flash-type heating coil generating low pressure steam. Hot water mixed with the steam in the heating coils acquires considerable velocity by virtue of the steam pressure and is directed by means of a hose and suitable atomizing nozzle upon the work to be cleaned.

Addition of a small percentage of suitable solvent expedites the removal of soil film even though it be cemented with road oils and grease. The solvent must be formulated to be noninjurious to the paint film in the proportions used. An excellent feature of this cleaning method is the lack of abrasion and removal of film which is otherwise in good condition.

So satisfactory was the first unit that two more have recently been ordered for early delivery.

9.6 MILE BELT CONVEYOR SYSTEM

What is believed to be the world's longest belt conveyor system was placed in operation early in May at Shasta Dam near Redding, Calif. It conveys aggregate from the loading plant at Redding, to the dam site at Coram, a distance of 9.6 miles. The conveyor has a travel speed of 550 ft. per minute and a capacity of approximately 1100 tons of sand and gravel per hour.

The conveyor system consists of 26 individual belt conveyor units, which are made up of over 16,000 Rex troughing and return idlers furnished by Chain Belt Co., and 20 miles of 36-in. six-ply belt, furnished by Goodyear Tire and Rubber Co. As each idler has three idler rolls, there will be a total of 40,500 rolls and 50,000 supporting brackets. All rolls are equipped with Timken bearings and high pressure greasing equipment.

The belt conveyor units are carried on supports varying in height from 4 to 90 ft. and each unit will be driven independently by 200 H.P. motors, except for three downgrade units which will generate their own power.

The course of the conveyor is through the middle of an 80-ft. right-of-way, cleared through manzanita brush its entire length. It crosses the Sacramento River at two points; over one main state highway and five county roads; across four creeks and the main line of the Southern Pacific Railroad. In several places the conveyor deviates from the straight line of haul to avoid hill tops on a direct line between the gravel plant at Redding and the delivery site at Coram.

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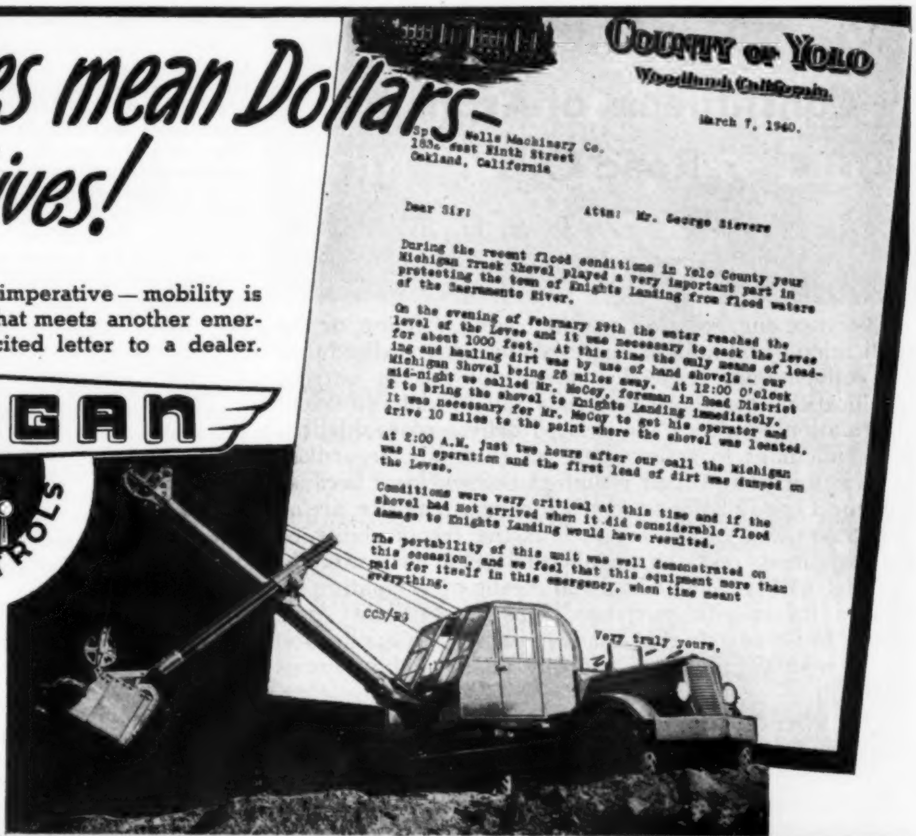

COUNTY OF YOLO
Woodland, California.

March 7, 1940.

Sp[illegible] Wells Machinery Co.
183[illegible] West Ninth Street
Oakland, California

Dear Sir: Attn: Mr. George Sievers

During the recent flood conditions in Yolo County your Michigan Truck Shovel played a very important part in protecting the town of Knights Landing from flood waters of the Sacramento River.

On the evening of February 29th the water reached the level of the Levee and it was necessary to sack the levee for about 1000 feet. At this time the only means of loading and hauling dirt was by use of hand shovels - our Michigan Shovel being 28 miles away. At 12:00 O'clock mid-night we called Mr. McCoy, foreman in Road District 2 to bring the shovel to Knights Landing immediately. It was necessary for Mr. McCoy to get his operator and drive 10 miles to the point where the shovel was located.

At 2:00 A.M. just two hours after our call the Michigan was in operation and the first load of dirt was dumped on the Levee.

Conditions were very critical at this time and if the shovel had not arrived when it did considerable flood damage to Knights Landing would have resulted.

The portability of this unit was well demonstrated on this occasion, and we feel that this equipment more than paid for itself in this emergency, when time meant everything.

CCS/RG

Very truly yours,

MICHIGAN POWER SHOVEL Co BENTON HARBOR, MICHIGAN, U.S.A.

Built for maximum speed and accuracy in measuring AGGREGATES, CEMENT AND WATER, Blaw-Knox Weighing Batchers are standard equipment in widespread use by road contractors, for general construction, material yards, and ready mixed concrete plants. They satisfy all modern specifications. Furnished for manual or automatic operation.

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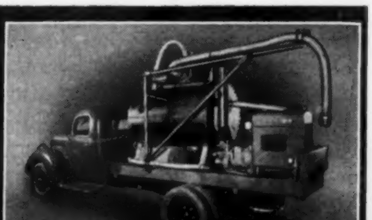

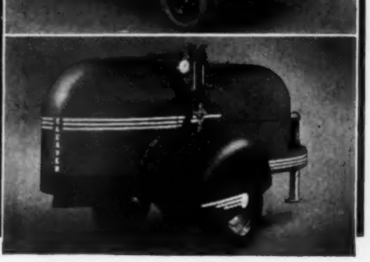

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Viscosity Index of the Oily Constituents of Asphaltic Road Oils

By E. G. SWANSON
Chief Chemist, Colorado State Highway Department

Everyone engaged either in the testing, refining, or the application of bituminous materials has long realized that the conventional tests that are employed in current specifications for those materials fail to yield sufficient information to afford the desired degree of evaluation. It is ridiculous to assume that all road oils, regardless of their source and their refining treatment, just because they meet specifications and sell for the same price, are of the same quality. Therefore, it is the responsibility of the bituminous research chemist to develop tests or methods that will serve as additional means of evaluating bitumens for specific purposes. This responsibility promoted the research that made possible the application of the viscosity index to the oily phase of bituminous material.

The Viscosity Index of an oil is a figure which indicates the tendency of the oil to change viscosity with increasing or decreasing temperature. It represents an inherent, constitutive property of the oil. An asphaltic or naphthenic type of oil has a high viscosity susceptibility to temperature changes, indicated by a low V.I., while a paraffinic type of oil has a low viscosity temperature susceptibility as shown by a high V.I. The data necessary for calculating the V.I. was first published in 1930 by Dean and Davis, Chemical and Metallurgical Engineering, Volume 36, Page 1618, 1929, and immediately won widespread approval as being perhaps the most important and significant characteristic in evaluating and classifying lubricating oils.

The constituents in bituminous materials can be separated by selective solvent action and preferential adsorption with Fuller's earth into three groups (Abraham's "Asphalts and Allied Substances, Fourth Edition," page 1007). The lyophobic asphaltic micelle, commonly called asphaltenes, may be precipitated by dispersing the bitumen in 86-88° Baume naphtha. The portion of the bitumen that is soluble in the above naphtha may be freed from the constituents known as asphaltic resins by the addition of Fuller's earth. The remaining phase, called the oily phase constituents, are obtained by filtration, washing of the Fuller's earth and by distillation to remove the 86-88° Baume naphtha. The oily constituents so obtained resemble and are similar to lubricating oil fractions in color, gravity, viscosity, etc.

The viscosity temperature susceptibility of this oily phase is then determined and expressed as viscosity index. The correlation of the V.I. values with known service behavior of various oils has been extremely gratifying.

The following specification and procedure has been developed by the Colorado state highway materials laboratory for determining the viscosity index.

Specification.—The viscosity temperature susceptibility of the oily constituents obtained from the residue from distillation (ASTM D 402-36) when expressed as Viscosity Index, according to Dean & Davis, "Chemical and Metallurgical Engineering," Volume 36, Page 618, 1929, shall be less than seventy (70).

Procedure.—For the determination of the Viscosity Index of the oily constituents of road oils.

Thirty (30) grams of the residue from distillation shall be placed in a 500 cc. glass stoppered Erlenmeyer flask and dispersed in 86-88° Baume petroleum ether (Merck—purified, B. P. 30-75° C.) The dispersion is then diluted with petroleum ether to a volume of 500 cc. and allowed to stand overnight. The malthenes are decanted, care being taken not to disturb the settled cake of asphaltenes, and filtered through a 50 cc. 2G-3 Jena glass fritted filter or a Buchner into a 2-liter vacuum flask. The asphaltenes remaining in the flask are re-dispersed with 200 cc. of petroleum ether and then transferred to the filter and washed with petroleum ether until the washings are practically colorless. The filtrate is transferred to a 2-liter Erlenmeyer flask, fitted with a rubber stopper, and the volume made up to approximately 1,100 cc.

450 grams of previously oven-dried (105° C.) 200 mesh Fuller's earth from Ivy, Utah, is added at room temperature to the filtrate and shaken vigorously for two minutes. The mixture is then shaken for one minute, every 10 minutes, for one hour.

The earth and absorbed asphaltic resins are removed by filtering through a 4A Buchner funnel into a 4-liter vacuum flask. It is imperative that the filtered earth be thoroughly washed with petroleum ether so as to effect complete removal of the oily phase constituents. Washing is accomplished by breaking the vacuum on the trap and adding approximately 300 cc. of petroleum ether to the earth. Vacuum is then applied until the portion that was used for washing is completely removed. This procedure is repeated at least six times.

The resultant solution is distilled in a one-liter distillation flask to a temperature of 400° F. (liquid phase). The oily constituents are then transferred to a 4-oz. Norton style tin, or to a lid from a one pound Gill type can, and placed in a drying oven at 105° C. for twenty (20) minutes. The oil so obtained is immediately filtered through a slightly heated 1G-3 Jena glass filter into a 30 cc. beaker.

The viscosities necessary for determining the Viscosity Index shall be obtained by the use of the Modified Ostwald Viscosimeter, ASTM D 445-37T and D 446-37T. Due to the fact that some oils may be heterogeneous at 100° F., which makes a true viscosity impossible, it may be necessary to determine viscosities at higher temperatures so that by extrapolation on the A. S. T. M. viscosity temperature chart (ASTM D 341-37T, Chart "A") the 100° F. viscosity value may be obtained. It is necessary that at least three points be established that fall on a straight line before a 100° F. value can be obained from the chart. It is recommended that viscosity values at 100°, 130°, 140°, 180°, and 210° F. be used and that they be plotted on the above mentioned graph to prove that all values are correct before the Viscosity Index is calculated.

STREET WIDTHS AND PARKING RESTRICTIONS

The State Highway Commission of Indiana employs the following yardstick for measuring street widths for parking restrictions on the 400 miles of city streets under the jurisdiction of the commission:

Under 30-foot—no parking either side.

30-foot and under 36-foot—parallel parking one side only.

36-foot and under 50-foot—parallel parking both sides.

50-foot and under 60-foot—angle parking one side, parallel one side.

60-foot and over—angle parking both sides.

These are not necessarily arbitrary limits, for consideration must also be given to traffic volume, street car lines and other conditions.

Traffic Growth on Indiana Highways—When the first state-wide traffic study was made in Indiana in 1933 it was found that there were more than ten million vehicular miles traveled daily on the state and county roads. In 1937 a second traffic study was completed and it was found that in four years the traffic flow had increased 40 percent. In other words, where there were in 1933 ten million vehicular miles daily, in 1937 there was a total of fourteen million vehicular miles daily over the state and county road systems. From checks made recently, it is indicated that the traffic flow on the state system has increased approximately 7 percent over previous figures and it is probable that a corresponding increase has taken place on the county roads.

EDITORIAL

ORDER THEM TO GO

DURING the period of the year when field construction activities are at a minimum, engineers foregather in annual conventions of associated groups. For the highway engineer, these annual conventions are useful. They are even economically justifiable, because from one small idea picked up by one of the engineers at a convention there may result a saving to the state, county, or city far greater than the annual cost of sending several engineers to the meeting. Highway engineering and construction progress and development is rapid. It soon speeds away from the man who does not keep up by reading, writing, and attending conventions.

Attending a convention is like going back to school. Many a time you have read and reread a passage in some text only to finish no more enlightened than when you started. When you got to the class room where questions could be asked you found your problem promptly cleared. Exactly the same thing is true regarding engineers and contractors conventions. Problems on which other men have worked are discussed and unexplained points are clarified by the speaker. This word of mouth explanation, with its inflections and intonations, is far more effective than the plain written or printed word.

You governors, you mayors, you chief engineers, you department heads, all of you should make it a point to see that funds are set aside to pay the expenses of certain of your engineers to certain conventions. The state, county, and city benefits financially and in improved service by what the engineers learn at conventions. Unless you give them the opportunity to exchange thoughts and experiences, your political subdivision is the loser. It requires more than reading to keep abreast of street and highway developments today.

SATISFY NATURAL LAWS

ENGINEERING construction is the production of a structure or utility of some kind. The design is based upon definite engineering laws, theories, and data. Resultant constructions as bridges, roads, dams, etc., are the visual evidence of the employment of engineering knowledge to the materials of construction. Those construction procedures which most economically fulfill the laws of engineering are naturally the most desirable. For performing the various constructions, equipment, materials, capital, and labor work jointly. With these abstract canons as a background we desire to point out that a definite responsibility lies in the laps of manufacturers and advertisers.

Engineers discover new laws, and develop new methods of employing construction materials. With this information they set up certain limiting requirements or specifications of procedure. Usually different construction procedures may be used employing varied construction equipment or different combinations of materials, to effect the desired result. The responsibility of the manufacturer and advertiser is that of telling engineers and contractors how their equipment or material satisfies the requirements of the engineer or the demands upon the material.

This editorial is not necessarily a criticism of any particular advertiser but rather a criticism of a type of advertising. Engineers and contractors want to know facts about a product. They want to know how the employment of the advertised equipment or material satisfies the laws of nature as interpreted by the engineer in his plans and specifications. Therefore, advertisers should tell facts, should give information about their products in their advertising. Technical or industrial magazine "advertising can be made most productive if the writer will try to make it just as informative, from the buyer's standpoint, as are the editorial pages." [Quoted from "Tell All"].

OKLAHOMA DIGS OUT

AGGRESSIVE, courageous action has finally pulled Oklahoma out of a quagmire of highway indebtedness. Diversion of highway revenues deleted the state highway funds of some $13,000,000 starting with the original severance in 1933. At that time 40 per cent of the gas tax revenues were diverted by the legislature to pay off the $13,000,000 General Revenue deficit mentioned. It took until July, 1937, to pay this off. The state has a four-cent gas tax, one cent of which goes to the counties. Naturally, during this period the state highway construction programs languished for need of necessary funds.

In 1937 the legislature passed a $35,000,000 road bond bill. This, however, was declared unconstitutional by the state supreme court the latter part of 1937.

All the while that diversion was in flower, the state highway department contracted for work with the result that unpaid, outstanding indebtedness was piling up. Materials and equipment suppliers who sold to the state naturally bid on prices sufficient to return carrying charges to them for the unpaid bills.

Among the campaign promises of Mr. Leon C. Phillips, in the gubernatorial campaign of 1938 were the cleaning up of the road debt and the placing of governmental departments on a budget basis. He was elected. He kept his promise.

In 1939 the legislature changed the highway law to make the commission a three-man board appointed by the Governor. Previously it had been composed of four men, three members and a member-secretary. The member-secretary was appointed for a two-year term, while the other members were appointed for six-year terms with a new man being appointed every two years. Under the old plan the commission members did their political horse trading with the majority senate group and the governor had no control over them. Under the 1939 law, Gov. Phillips appointed Sandy H. Singleton of Duncan as Chairman. George A. Meacham, a Clinton attorney, and H. E. Bailey of Perry, who was a former division engineer, were appointed as the other two members. They took office on Jan. 17, 1939. This commission promptly began paying the highway indebtedness. Special audit authorized by the 1939 legislature disclosed a debt of $5,500,000 when the new commission took charge, but the last of the old bills was paid Oct. 31, 1939. The commission is now on a pay-as-you-go basis.

It should be understood that the diversion of gas tax

receipts ceased when the $13,000,000 General Revenue deficit was cleared up. Payment of these old debts naturally curtailed construction. In the process, the pay roll dropped from about 2,700 persons to about 1,700.

The upshot of this honest procedure has been to begin to get discounts as high as 25 percent for materials and equipment purchased by the department. The average lowering of costs amounts to about 15 to 20 percent.

Unless some other kind of polecat jumps into the picture, the state is well on its way toward a sensible improvement program. The roads are certainly nothing to brag about now, by-and-large, but a couple of more years of this honest, clean administrative effort and the highways of Oklahoma will be inviting.

Diversion, politics, and financial bungling soon shows up on the highway system of a state.

MAKING HEADWAY

INTERFERENCE in a state's highway program by political influence usually results in payroll packing, reduction of construction funds, and excess maintenance expenditures. Kansas was no exception to this order of events. It is no criticism of Kansas, specifically, that construction funds dwindled and high maintenance expenditures were recorded. That's only one of the results of political highway management and Kansas can lay no claim to individuality in this regard. Kansans, like the citizens of so many other states, have felt that progress in the construction of new and long-lived highways was unsatisfactory. But there was almost no experience in their own state or neighboring states by which they could measure the efficiency of highway management. It was all of a similar character. And, too many of the factors like income, mileage and maintenance costs, continued to fluctuate from year to year. If there happened to be a year of good management it was too easy to believe it was a result of a change of some other factor. If management was particularly poor it was too difficult to discover. So conditions were ideal for the continuation of inefficient political management. This pertains to highway matters for many years, and is not intended to be construed as a reflection upon any particular administration, man, or set of men. It is, fundamentally a criticism of a practice that has grown up in too many states without recognition of its disastrous effects on a progressive highway program.

What has happened that has changed the practice? What has the present highway commission done to increase the new construction expenditures? What have Kansans learned from the passing years to convince them that they would have had many more miles of good highways if their problem had been tackled differently?

With the assistance of state highway planning survey data they have learned that a little long distance vision and plenty of cooperation can get an increased new construction program started. They have learned that a little intestinal fortitude applied to the eradicaion of policical ham-strings greatly reduces maintenance expenditures and increases the new construction budget. Instead of having only about 1¾ million dollars available for matching federal aid, they have increased this to nearly 4 million dollars by eliminating political payrollers and reducing maintenance expenditures. During the year about 1100 payrollers have been released, it was claimed by the director of the commission.

An analysis of state highway income and disbursement of Kansas for the calendar year 1939 is as follows:

Income	
Net gas tax	$ 9,722,000
Motor vehicle license fees	3,580,000
Motor carrier fees	1,167,000
Miscellaneous	30,000
Total Highway Fund Income	$14,499,000
Statutory Expense	
Benefit district refunds	$ 1,000,000
County and township road fund	3,600,000
Highway anticipation fund	336,000
City maintenance	70,000
Port of entry expense	174,000
Highway patrol expense	181,000
Total	$ 5,361,000
Operation and State Construction	
Administration	$ 400,000
Maintenance, resurfacing, equipment	3,579,000
Plans and surveys	297,000
Right-of-way	497,000
State construction	247,000
Damages, compensation and miscellaneous	144,000
Total	$ 5,164,000
Available to match federal aid	3,974,000
	$14,499,000

The highway commission has no control over the statutory expense items; they are specified by law. The balance of $9,138,000 is budgeted to the various headings by the commission. A progressive construction program requires a considerable increase in two items—"state construction" and "available to match federal aid." Increasing the latter will permit the state to take up some of their back federal funds. The one big place where reductions in sizeable amounts could be made is in the maintenance item. This they have done. A considerably enlarged construction program is in the cards for 1940.

Some remarks should be made regarding the county and township fund item of statutory expense. There is no accounting for these expenditures. Kansans are entitled to know that their gas tax and motor vehicle license fee funds are being spent for the roads which they think this money is buying. Therefore, some legislative act should be passed requiring a full accounting for these funds, and requiring that they be spent for road building.

The other large item, $1,000,000 of statutory expense for "benefit district refunds" is the result of an enactment by the legislature in 1930 requiring the state highway department to pay off all county bond obligations incurred through the organization of benefit districts by the counties for certain road work. The approximate amount of those bond issues in 1930 was a little over $26,000,000. The 1930 act required the state to pay off these bonds at the rate of $1,000,000 per year. For further discussion of this matter see another editorial.

It is to the credit of this present commission that funds for "state construction" and for "available to match federal aid" have increased over the 1938 calendar year, and that the 1940 schedule is considerably improved over this schedule. Kansas is on the way out of the quagmire of political mismanagement onto the basis of business management. It is to be hoped that the director of the commission and the governor will have enough strength of character to resist a further intrusion of political appointments for appeasement. Citizens of Kansas need much better roads. They are paying for them. It is the public duty of the commission, and of the Governor, to see that Kansas' citizens get more new construction.

FORGET THE WATER OVER THE DAM

LEGISLATIVE enactment in Kansas in 1929 saddled the state highway revenues with a little over $26,000,000 worth of outstanding county bonded indebtedness, including interest payments. The law stipulates that the debts are to be paid off at the rate of $1,000,000 per year. When this law was passed, the legislature failed to repeal the law by which most of this indebtedness was contracted, thus leaving a weak link in highway legislation. The link leaves a loophole for political pressure to be exerted on highway funds in Kansas.

Following is a record of this indebtedness and the payment schedule as made up by the research department of the Kansas Legislative Council from the records of the State Highway Commission, as of January 1, 1939:

It was previously stated that the "benefit district" law was not repealed. Districts may still be organized and bonds may still be sold. These obligations have the effect of decreasing state highway construction revenues while at the same time more milage is added to the already too large state highway system.

It seems to the writer that Orders No. 5 and 6 should be canceled from the law. Tax money has already been collected and the bonds redeemed for these items. As stated, it is "water over the dam." What assurance have the gas and motor vehicle taxpayers of Kansas that these refunds will be spent for improving county and township roads? None. There is no accountability to the state for the expenditure of these funds. A glance at these two columns will show the highway engineer how many more improved miles of road could be built where improved roads are most needed. The total of these two columns represents a sizable annual construction program. And the state highways of Kansas can use this.

ORDER AND AMOUNT OF PAYMENTS ON BENEFIT DISTRICT ROADS

To Be Paid	Landowners Share Due County Order No. 1	Refunds to Landowners Order No. 2	Township Share Current Maturities Order No. 3	County Share Current Maturities Order No. 4	Total	Available For Township Refund Order No. 5	Available For County Refund Order No. 6	Total Annual Appropriation
1939	$200,470.21	$ 90,321.22	$216,697.38	$ 482,285.40	$ 989,744.21	$ 10,225.70		$ 1,000,000.00
1940	183,321.48	75,462.21	203,685.97	451,761.19	914,230.85	85,769.15		1,000,000.00
1941	124,192.62	25,161.78	143,921.85	329,162.49	622,438.74	377,561.26		1,000,000.00
1942	83,074.03		107,476.63	250,059.26	440,609.92	559,390.08		1,000,000.00
1943	63,658.15		80,365.20	191,049.14	335,072.49	664,927.51		1,000,000.00
1944	40,901.59		51,858.50	127,184.37	219,944.46	780,055.54		1,000,000.00
1945	31,833.31		42,326.51	108,035.08	182,194.90	817,805.10		1,000,000.00
1946	20,840.02		29,197.21	73,019.28	123,056.51	876,943.49		1,000,000.00
1947	13,056.18		19,352.46	48,872.16	81.280.80	409,095.14	$ 509,624.06	1,000,000.00
1948	6,070.26		8,144.68	20,567.06	34,782.00		965,218.00	1,000,000.00
1949	4,555.11		6,137.34	15,386.92	26,079.37		973,920.63	1,000,000.00
1950	4,011.80		6,035.24	14,969.05	25,016.09		974.983.91	1,000,000.00
1951	2,520.53		3,764.49	9,604.74	15,889.76		984,110.24	1,000,000.00
1952	315.06		461.70	1,203.26	1,980.02		998,019.98	1,000,000.00
1953							1,000,000.00	1,000,000.00
1954							1,000,000.00	1,000,000.00
1955							1,000,000.00	1,000,000.00
1956							1,000.000.00	1,000,000.00
1957							376,255.06	376,255.06
	$778,820.35	$190,945.21	$919,425.16	$2,123,159.40	$4,012,350.12	$4,581,773.06	$9,782,131.88	$18,376,255.06
Paid Prior to 1939	$3,443,059.48	$2,735,247.56	$468,435.85	$1,046,731.76	$7,693,474.65			$ 7,693,474.65
Grand Total of Funds Paid and Required								$26,069,729.71

The first column, Order No. 1, lists refunds made by the state to the county treasurers from 1929 to the date of final payment, 1952; and it shows the status of the order from 1939. These funds are used by the counties to pay the landowners' share of current maturing benefit district bonds. The figures include principal and interest.

Order No. 2, lists refunds due the landowners, on taxes already paid. These refunds are made direct to the landowners who originally paid the tax, and include principal and interest.

Order No. 3, lists amounts due to townships on unpaid benefit district bonds and is the principal only. The refunds are returned to counties and are used to pay township share of current maturing benefit district bonds.

Order No. 4, similar, except that the refund represents the county share of current bond maturities.

Orders Nos. 5 and 6 are amounts of bonded expenditures that were paid off by the townships and counties before the enactment of the law and really is "water over the dam."

This indebtedness was contracted by "benefit districts" under a law permitting counties and townships to sell bonds to finance roads to be built by these districts. In 1929 a generous legislature loaded these debts and the roads onto the state highway commission.

FULL TIME CHAIRMAN

FREQUENTLY the writer has expressed criticism of highway bridge overdesign. Bridge engineers have problems. In fact, so much needs to be done both with respect to new design and toward coördinating and crystallizing opinion on the rating of old designs that a full time chairman is needed for the bridge committee of the American Association of State Highway Officials. This man should be one who should answer to no state nor to the Public Roads Administration. Maintenance funds for the office should be contractual over a period of years with the states and the Public Roads Administration.

The late Mr. Gemeney was an aggressive, progressive, well liked leader for the bridge committee. He could not spare enough time from his PRA duties, although he worked many extra hours, to give as much attention to the growing bridge problems as was necessary.

We suggest the name of Mr. Donald Witten as chairman of an independently financed bridge committee of the A.A.S.H.O.

NEW EQUIPMENT AND MATERIALS

New Line of Four Wheel Scrapers

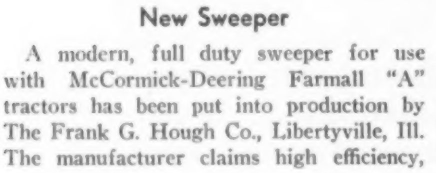
A new improved line of four-wheel scrapers, in a complete range of sizes matched to the new line of International TracTracTors, has been introduced by Bucyrus-Erie Co., South Milwaukee, Wis. These scrapers have only five main parts, consisting of: (1) Frame with Side-plates, (2) Tilting Bowl, (3) Apron, (4) Tongue Assembly, and (5) Rear Axle Assembly. They have two-line cable control, one cable to control height of digging edge, and the other to control the opening of the apron

New Scraper

and tilting of the bowl. In dumping, the bowl is tilted upward through an arc between the side-plates of the frame to an almost vertical position. The tilting bowl consists of a simple reinforced double-bottom plate curved below and behind the dirt, and rotating between the fixed side-plates of the frame. The front edge of the tilting bowl is hinged to the frame, just behind the digging blade, by means of a full-length solid bar. As it rotates about this hinge in dumping, the bottom of the bowl lifts, thus ejecting the dirt with a rolling motion. The cutting edge is the exclusive Bucyrus-Erie double-curve type. Stability for digging, dumping, and finishing on side slopes is provided by wide wheel spread and low center of gravity. Rope life is increased by keeping the cable free of twisting bends, passing it over a minimum number of large roller-bearing sheaves (all duplicates and interchangeable) which are all set in a vertical plane along the center line of the scraper. Hauling of the loaded scraper is made easy by the constant wheelbase, which maintains even distribution of load during the entire cycle.

New Sweeper

A modern, full duty sweeper for use with McCormick-Deering Farmall "A" tractors has been put into production by The Frank G. Hough Co., Libertyville, Ill. The manufacturer claims high efficiency,



New Hough Sweeper

simple, flexible operator control of all working actions, easy brush lift and adjustable broom pressure. A rugged, durable, automotive torque tube drive from the rear power take-off is carried below the tractor to a gear box behind the broom where power is converted right and left to heavy duty roller chain drives on both sides of the broom. Broom is 30 in. in diameter, 72 in. long, sweeps a 60-in. path and operates at approximately 1/10th of engine speed. Dust hood covers broom to confine float dust and protect equipment and operator.

New 1¼ Yd. Excavator

A new 1¼-yd. excavator, featuring vacuum control has been brought out by the Thew Shovel Co., Lorain, O. This model is known as the Lorain-69 and is available with a complete line of interchangeable boom equipment as a shovel, dragline, 18-ton crane, clamshell, backdigger and skimmer scoop. The revolving turntable of the Lorain-69 is built to the Thew center drive design and follows very closely the proved design and construction principles of all Lorain machines. The turntable may be powered by a Caterpillar Diesel, a gasoline engine, or an electric motor of any standard commercial type to suit specifications. The swing clutches, crowd brake are all vacuum controlled. The method used

Lorain-69 1¼-yd. Excavator

is the "vacuum-plus-air" booster type, designed as a "closed" system. In this method the standard mechanical linkage from hand lever to clutch is retained, and the vacuum valve is connected into this linkage. This turntable is mounted on a center "chain" drive crawler, 12-ft. 9-in. long and 10-ft 2-in. wide when equipped with standard 24-in. treads. Extra wide 32-in. "Swamp treads" are available. The crawler is propelled at two travel speeds—high, 1½ M.P.H.—low ¾ M.P.H. Steering may be effected in either direction at either speed, to give the unit the maximum maneuverability. The shovel boom is 21 ft. long from pin to pin, and is equipped with large 36 in. diameter boom peak sheaves. It is equipped with an 18-ft. dipper stick. At 45° boom angle, the maximum digging height is 25-ft 2-in.; the maximum digging radius is 30-ft. 10-in. The shovel boom of the Lorain-69 is an all-welded, all steel design. The dipper stick is an all-steel, all-welded structure of rectangular cross-section and is equipped with a spring mounted greenhorn cap to eliminate impact shocks. On draglines, the fairlead is mounted at the front of the turntable bed, between the boom feet. It provides a direct lead from drum to bucket, through a sheave arrangement which keeps the drag cable in constant contact with the sheaves.

Pipe Locating Device for Excavators

A new automatic signal device, designed to forewarn the excavator operator by an audible signal as his bucket approaches hidden underground pipes or cables, has been announced by Wallace & Tiernan Products, Inc., Belleville, N. J. Known as the WTP automatic pipe anticipator, this new unit is said to pay for itself, on difficult jobs where

The Pipe Anticipator

pipes are many and work is slow, in as little as one or two days. The pipe anticipator is designed for use in street excavation for installing or repairing pipe or cable lines, for electric power, communication, traffic signal, fire alarm, water, gas or sewer; for subway, highway or street construction; at power plant and industrial yards requiring any kind of excavation; at petroleum and natural gas pipe line systems, for installation near other lines or for finding, uncovering and repairing existing lines; and for dredging where pipes and cables may exist in channels. The pipe anticipator may be attached to any type of excavating or pushing machine. It produces a continuous sound which the operator hears either through a loud speaker or ear phones. As the bucket of the excavator approaches a pipe or cable obstruction, the sound volume increases. It is said that the operator requires very little experience to dig to within a few inches of hidden pipes or cables with assurance. Thus, the removal of excavated material, otherwise requiring laborious hand tool methods, may be accomplished quickly and efficiently by machine.

New Line of Diesel Power Units

Several months ago the International Harvester Co., 180 North Michigan Ave., Chicago, Ill., announced the new modernly styled 100-H.P. Model UD-18 Diesel power unit. Now, three new similarly styled and engineered International power units, all smaller than the UD-18, have just been announced. They are the UD-6, smallest in the new line, which develops 39 H.P. at 1500 r.p.m.; the UD-9, the next in size which develops 53 H.P. at 1500 r.p.m.; and the UD-14, which develops 66½ H.P. at 1300 r.p.m. International Diesels are full Diesel engines. They are provided with a distinctive method of starting by which each starts on gasoline and, after a minute or less of operation shifts to full Diesel operation. When the change-over is made, spark plugs, carburetor and auxiliary combustion chambers used on the gasoline cycle

New International Diesel Power Unit

are shut off and have no connection with the Diesel operation. International Diesels may be cranked by hand as easily as gas engines of like sizes. An inexpensive standard 12-volt electric starting system may also be utilized to provide electric starting. Other features worthy of mention of each new model are 4-cycle, valve-in-head design; long-life cylinders with full-length jackets; full-pressure lubrication through drilled passages; oil pump with Floto screen; Tocco-hardened crankshaft; heavy-duty precision bearings; by-pass type, thermostatically controlled cooling; full-floating water pump shaft; full-floating piston pins; variable-speed governor; large-diameter flywheel; large-capacity oil-bath type air cleaner; renewable element oil filters; equipment combinations to meet wide variety of requirements. The 39-H.P. UD-6 Diesel has 3⅞-in. bore and 5¼-in. stroke, and piston displacement of 247.7 cu. in. Its length is 62 7/8 in., width 25⅜ in. and height 50¼ in. Approximate weight is 1,765 lbs. The 53-H.P. UD-9 Diesel has 4.4-in. bore and 5.5-in. stroke and piston displacement of 334.5 cu. in. Its length is 67¾ in., width 26⅞ in. and height 52 in. Approximate weight is 2,085 lb. The 66½-H.P. UD-14 Diesel has 4¾-in. bore and 6½-in. stroke and piston displacement of 460.7 cu. in. Piston speed at 1300 r.p.m. is 1408 ft. per minute. Its length is 78 in., width 33⅛ in. and height 56½ in. Approximate weight is 2,585 lb.

New Hydraulic Dump Hoist for Small Trucks

A hydraulic dump hoist for installation on the ½, ¾ or 1-ton truck chassis, has been placed on the market by the Bird-White Corporation, 624 South Michigan Ave., Chicago, Ill. The equipment is designed for the lighter jobs up to 2,000 lbs. payload. High pressure hydraulics is responsible for the new performance of this hoist. The compactness of the entire mechanism makes possible both low mounting, low loading height and light weight. The loading height is 48 in. Operating features include maximum dumping angle of 60 degrees, cab controlled, raising and lowering dump body while the truck is in motion, high speed operation in raising and lowering the hoist

New Hydraulic Dump Hoist

and minimum sidesway and top heaviness. Two high pressure hydraulic rams are used to operate the hoist. These are mounted well forward of the hinge points in a vertical position, affording a direct lift to the load, thereby eliminating all cramping.

New Scraper

A new scraper, rated at 25.8 cu. yd. struck capacity and 35 cu. yd. heaped, has been added to the line of R. G. LeTourneau, Inc., Peoria, Ill. This Model N is designed for pusher loading. It is constructed with higher sides and a larger apron. A longer and steeper cutting blade base, facilitating easy and fast loading, causes material to boil in—to flow back into the bowl and forward into the apron. Cable controlled fractional inch cutting, positive ejection and measured spreading are attained through the instant response of the power control unit. Several important new features are introduced by the Model N. Additional yards were added to its capacity by extending and building a higher apron. Instead of placing a lifting sheave on the apron where it would often be covered by and worked through dirt, the cable was dead ended on the apron, and the apron sheaves placed on top of the spring pipe, where they travel back and forth in a slide—entirely eliminating abrasive cable wear caused by dirt getting into them. Easier passage of sticky materials is permitted by an arched "A" frame which also adds strength. Ample flotation and needed compaction is obtained and resistance minimized by the use of four large 24 x 32 tires, 80 in. high. A goose neck yoke gives greater tire clearance.

Model N Scraper

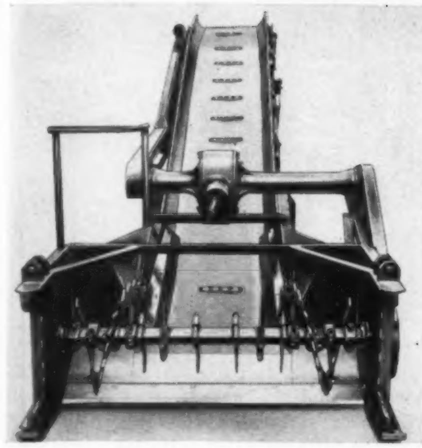
New Gasoline Power Units

In January of this year the International Harvester Co., 180 North Michigan Ave., Chicago, Ill., announced a new 4-cylinder, 22-H.P. gasoline power unit, the Model U-2. Now, two new gasoline models are being announced, the 4-cylinder, 31.5-H.P. Model U-4 and the 4-cylinder, 41-H.P. Model U-6. Both the U-4 and U-6 are of valve-in-head design, have replaceable cylinder sleeves, efficient combustion control, replaceable precision-type bearings, Tocco-hardened crankshafts, and efficient pressure lubrication. Maximum horsepower for the U-4 and U-6 are 31.5 and 41 at governed speeds of 1800 and 1500 r.p.m. respectively. The bore and stroke of the U-4 are respectively, 3⅜ and 4¼ in.; of the U-6, 3⅞ and 5¼ in. Piston displacement of U-4 is 152.1 cu. in. and of the U-6, 247.7 cu. in. The U-4 is 54¾ in. long, 23 1/16 in. wide and 40 in. high and weighs approximately 920 lb. The U-6 is 62 5/16 in. long, 25⅜ in. wide and 50¾ in. high and weighs approximately 1400 lbs.

New International Gasoline Power Unit

New Loader for Removing Surplus Material from Shoulders

A belt conveyor loading attachment for the A-W "99" power grader, for picking up and delivering into trucks waste material from shoulders along paved highways, has been developed by the Austin-Western Road Machinery Co., Aurora, Ill. It is stated the loader will handle clay, mud, sod, grass, and all the usual material to be removed from ditches or shoulders, leaving the surface smooth and undisturbed, with the correct slope toward the ditch. Cutting down grass shoulders offers no problem. The collecting bowl at the bottom gathers the dirt as the "99" power grader moves forward, and by means of ribbon screws and cutters, feeds the dirt onto the moving belt. A regular grader blade-bit at the front of the collecting bowl has a combined cutting and levelling action. Power for the "99" loader is taken



New A-W Model "99" Loader

from the main engine, through a special clutch, and control of belt movement is instantaneous and constant by the loader operator. The "99" loader attachment is suitable for any "99" power grader, new or old.

New Portable Printer

A new portable printer designed to reproduce engineering drawings, letters, maps, charts, printed forms, etc., up to a maximum size of 12 in. by 18 in., has been developed by the Ozalid Corporation, Ansco Road, Johnson City, N. Y. Exposure is made by placing the drawing face up on the Ozalid sensitized paper and locking both in a contact frame hinged to the cabinet proper. The light source consists of six specially designed lamps, and exposure is regulated automatically by a time release switch, and usually takes 2 to 4 minutes depending upon the type of original used. The Ozalid print is developed dry by placing it in a developing chamber which is located behind the reflector. Development takes from 2 to 4 minutes, and when the print is removed from the developing chamber it is absolutely dry and ready to be used. As many as six prints can be developed simultaneously. This equipment operates on an ordinary lighting circuit of 110 volts AC or DC. It is light in weight and can be easily moved from place to place and conveniently plugged in to any electrical outlet.

New Elpro Portable Printer

New Truck Body Under-Structure

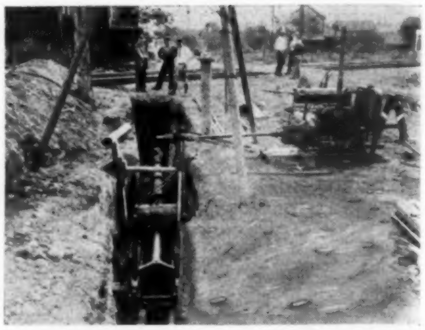
A new type of dump truck body which has a patented truss under-structure is now being manufactured by Gar Wood Industries, Inc., Detroit, Mich. The new trussed under-structure is stated to provide direct full-length support to the floor by integral longitudinals in combination with new trussed type crossmembers resulting in a more rigid body. The sides and floor sections which form the body longitudinals are welded integrally by the newest scientific manufacturing method giving maximum strength to the floor in resisting shocks and sudden load impacts. The new body under-structure also is stated to provide greater strength in the center area of the floor. The trussed under-structure is available with all types of the Gar Wood "C" line of bodies, which are equipped with

New Dump Truck Body With Trussed Under-Structure

models D6 and D7 direct-lift underbody hydraulic hoists and F1CS patented cam and roller hoists.

New Horizontal Boring Machine

A new boring machine, stated to install casings up to 36 in. diameter for water lines, gas and oil lines, sewers, conduits, etc., under highways and railroads or through embankments, has been placed on the market by the Young Engine Corporation, Canton, O. This machine is fundamentally a horizontal rotary drill using the pipe or casing to be installed as a medium for carrying the rotating cutter head. Flexible and adjustable power connections are provided to meet all operating conditions. In operation, the machine is placed in the ditch with a 20/30 H.P. gasoline power unit set up on the bank at the side. The casing to be installed is attached to the driving head of the machine which is an 8-in. x 13½-in. forged steel flange on the forward end of a rotating hollow sleeve. The combined rotating and forward thrust of the sleeve forces the pipe with cutter head into the embankment. After the hollow driving sleeve has been advanced to its full extent, it is unflanged from the casing and returned to its starting position. Then an 8-in. x 6-ft. flanged extension joint is inserted between the rear end of the pipe and the driving sleeve. This operation is repeated until the total length of the inserted extension joints exceeds that of the next joint of casing. All the extension joints are then

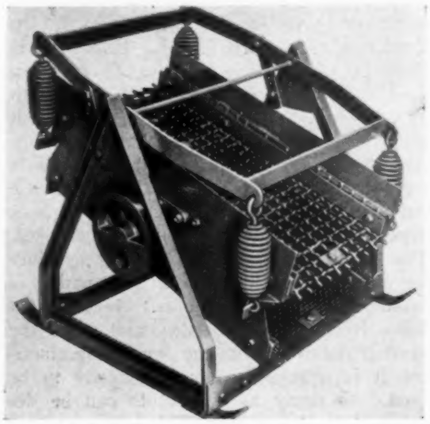


Young Boring Machine

removed and the next section of pipe is welded or screwed to the preceding one, and the cycle of operations is continued. The driving sleeve is hollow to permit the removal of dirt through the pipe. The cuttings are removed preferably with water where it is available, or a scoop may be used.

New Screen for Contractors

A screen designed particularly for the accurate sizing and salvaging of crushed stone, and and gravel at contractors' roadside plants or bridge abutment and other concrete construction work, has been brought out by the Robins Conveying Belt Co., Passaic, N. J. The screen is driven by a 2 HP gasoline engine or a 1 HP electric motor. The screening surface is 16 in. wide and 36 in. long. The vibrator is of the unbalanced weight type. The frame is welded structural steel.



Contractor's Screen

Tree Moving Crane

Gar Wood Industries, Inc., Detroit, Mich., has obtained exclusive rights to manufacture and sell a tree moving crane unit for use on truck chassis, in accordance with a license agreement with co-inventors Paul H. and James A. Davey, both associated with the Davey Tree Expert Co., Kent, O. This all-purpose unit, particularly suitable for 1½-ton truck chassis, is called the Gar Wood "Q-D" (quick detachable) tree moving crane, which can be erected or removed in ten minutes. The winch is used to pull the structure up onto the truck. The unit consists of an all-steel platform body, winch with niggerhead quick-detachable crane (complete with wire

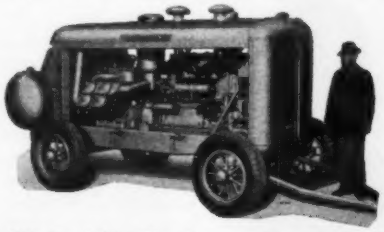
rope), universal sheave block, complete rack sides, two-speed forward and reverse power take-off, all controls, adjustable jacks and tool boxes. With the crane in place, tree balls up to 6 ft. in diameter and three tons in weight are quickly picked up, transported and reset. When the tree crane unit is removed the platform is left clear with the winch in place for other work during the off season.

Improvements in Novo Diaphragm Pumps

The Novo diaphragm pumps, Model AD, of the Novo Engine Co., Lansing, Mich., have just been improved at the following 6 vital points: 1. Power transmission and reduction is by helical cut gears, increasing efficiency and quietness of operation. 2. The eccentric shaft is bronze-bushed which cuts down wear and servicing and allows economical replacement when necessary. 3. A clean-out hand hole has been placed on the suction side and provides a means of cleaning the pump in 3 minutes. It is not necessary to remove the diaphragm to clean pump of sand and debris which might cause damage. 4. Plate on clean-out hand hole is secured by handle nuts which can be removed with ease without use of wrench. 5. Gear case has been made oil tight allowing gears to be flooded with oil, greatly increasing life of these parts and reducing noise. 6. Suction and discharge have been threaded on the inside to receive a full 4-in. connection to allow a freer flow of water and increasing capacity.

New 500 Cu. Ft. Portable Compressor

A new portable compressor delivering 500 cu. ft. per minute at 100 lb. pressure has just been announced by Ingersoll-Rand



K-500 Portable Compressor Powered with Gasoline Engine

Co., 11 Broadway, New York. Known as the K-500, this machine is now the largest in their line of two-stage, air-cooled units, and weighs only 10,600 lb. Features of this new portable compressor include: choice of iether an oil engine or a new-type 6 cylinder gasoline engine which does not require high-grade motor gasoline, replaceable cylinder liners for engines, and a patented automatic fuel saver which changes the engine speed according to the use of compressed air. This new unit is offered with either wheel- or skid-mounting.

6-Cylinder Diesel for Ford Trucks

A 6-cylinder Diesel unit for both cab-over-engine and conventional Ford trucks has been placed on the market by The Buda Co., Harvey, Ill. This package unit has been compltely engineered so that it can be readily and easily installed. In fact, several installations have been made, not only at the Buda factory but also in the shops of Buda branches and distributors.

Thornton Four Rear Wheel Drive for Fords with Two Speed Axles

The Thornton Tandem Co. now has available complete data on the Thornton four rear wheel drive unit for Ford trucks with two speed axles. This unit is stated to provide capacities up to 15 tons gross vehicle weight and is for use when it is necessary to have even greater loads and performance than those made possible with the standard single speed Ford axle with the conventional Thornton Ford drive unit. The frame reinforcement is designed to accommodate gross vehicle capacities up to 30,000 lbs. Massive dual spring suspension is also provided to give proper support for the load with adequate protection against road and load shock. The inter-axle gear case is equipped with the Thornton automatic-locking Differential providing positive drive to both rear axles. A data sheet giving performance data in both the Ford speed and Ford power ratios is available on application to the Thornton Tandem Co., 8701 Grinnel Ave., Detroit, Mich.

New 67 Lb. Sinker Drill

A new 67-lb. sinker, known as the S-73, has been announced by the Gardner-Denver Co., Quincy, Ill. Four-pawl rotation feature, which has proved successful in other Gardner-Denver drills, is incorporated in the S-73. The pawls are reversible for double wear. The valve design permits unrestricted admission of air with an extremely short valve stroke. The drop forged

cylinder has a bushing with renewable bronze liner. The chuck end is drop forged and is available in any style. A large oil reservoir surrounds the cylinder bushing and feeds oil automatically to all working parts of the drill. The Sinker has ¾-in. side rods of special stock, with long cap nuts to protect the thread.

Improved Novo Road Pump

The road pump of the Novo Engine Co., Lansing, Mich., has been redesigned to include the following improvements: The overall design has been streamlined with a lower center of gravity for both pump and power unit. The power transmission is by multiple silent roller chain. There are only two reductions from the power unit to the pump crankshaft, resulting in an extremely high pump efficiency. Herring-bone gears in the pump give efficient transmission of power. Each cylinder and each set of valves has a separate cover to allow inspection and repair by removing that plate only. A spacious tool-box has been included at the rear of the pump in what was formerly waste space. Truck wheels are roller bearing equipped, allowing easier portability.

WITH THE MANUFACTURERS

McNutt New LeTourneau Advertising Manager

G. C. McNutt

George C. McNutt, formerly associated with the Bert S. Gittins Advertising Agency as account executive on Allis-Chalmers, Bucyrus-Erie and other industrial accounts, has assumed his former position as advertising manager of R. G. LeTourneau, Inc., effective April 1st. Mr. McNutt fills a position vacated by the resignation of George R. Huffman. Following his graduation from the University of California in 1926, Mr. McNutt had a varied career as free lance writer and newspaper man before entering the industrial advertising field with the west coast division of the Caterpillar Tractor Co. and later the American Tractor Equipment Co. In 1935 he accepted a position as advertising manager for R. G. LeTourneau, Inc., which position he held until 1937, when he joined the Bert S. Gittins Advertising Agency of Milwaukee, Wis. Mr. McNutt is well-known throughout the industry and the advertising field. Since the inception of the Construction Equipment Advertisers in 1939 he has served as Secretary-Treasurer.

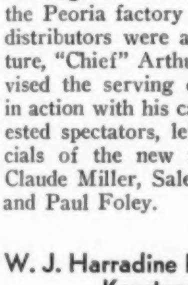
New Distributor Hoist at Buffalo Feast

More than 700 highway commissioners, contractors and farmers of eastern Kansas attended the open house for the new "Cater-

Serving Up the Buffalo Meat

pillar" distributorship, Karcher-Wolter-Foley Co., successor to the G. C. Dunn Tractor Co., of Wichita, Kan., which was held throughout Saturday, April 20. The piece-de-resistance was 1000 lbs. of choice buffalo cuts from three of these animals purchased from the government reservation in South Dakota. The event included a program of vaudeville and motion pictures. A delegation of "Caterpillar" officials from the Peoria factory and several neighboring distributors were also present. In the picture, "Chief" Arthur Wolf, Jr., who supervised the serving of the barbecue is seen in action with his carving knife. The interested spectators, left to right, are the officials of the new firm: George Karcher; Claude Miller, Sales Manager; Ed Wolten and Paul Foley.

W. J. Harradine Elected Vice President Keystone Driller Co.



W. J. Harradine

W. J. Harradine has been elected a director, vice president and general manager of Keystone Driller Co., with Falls, Pa., Joplin, Mo. and Arlington, N. J. The company was recently reorganized under Section 77B of the Bankruptcy Act, and the new board of directors held its organization meeting shortly thereafter. Mr. Harradine was previously associated with the company in an executive capacity, but during the period of reorganization was connected with the Buckeye Traction Ditcher Co. in charge of the Washington, D. C. office. He has returned to Beaver Falls to take an active part in the rehabilitation of the company which has gotten under way at an accelerated pace since the reorganization was finally approved in U. S. District Court in Pittsburgh, Pa. It is now believed that with ample working capital and an energetic management, the company quickly will re-establish the prestige it long enjoyed in its nearly 50 years of history. Already, it is reported, inquiries from both export and domestic sources for the company's products have increased, and it is also said several notable improvements have been made in drills, one of the chief products. Keystone Driller Co. is engaged in the manufacture and sale of cable well drills, power excavators and water pumps. It maintains and operates a manufacturing plant in Beaver Falls and assembly plants in Joplin and Arlington.

Robins Conveying Belt Co. Moves General Offices

The general office of the Robins Conveying Belt Co., manufacturers of material handling equipment, heretofore at 15 Park Row, New York, has been moved to an office building just completed at the company's plant at Passaic, N. J. An office also will be maintained at 70 Pine St., New York.

William H. Wood Now Distributor for Rubber Associates

William H. Wood of Austin, Tex., has resigned as Materials and Tests Engineer for the State Highway Department of the State of Texas and will act as distributor in the Southwestern area for the rubber expansion joint compound manufactured by Rubber Associates, Inc., Rockefeller Center, 1230 Sixth Ave., New York, N. Y. Mr. Wood's district will embrace the States of Texas, Oklahoma, Arkansas, Mississippi and Louisiana.

W. R. Adams Dies

After an illness of three weeks, W. R. Adams, President of J. D. Adams Co., Indianapolis, Ind., died on April 5 at Los Angeles while on a brief vacation. Mr. Adams, well known and respected in the road machinery industry, had been very active in the development and management of the company since his graduation from Purdue University in 1910. He succeeded to the presidency of the firm in March, 1938, when his surviving brother, Roy E. Adams, assumed the office of chairman of the board.

W. R. Adams

Mr. Adams leaves a host of friends and business associates who admired him for his character, integrity, and his stabilizing influence in the industry.

New Distributors for Stewart-Warner Accessories

Appointment of three new distributors for Stewart-Warner accessories has been announced by George Zahn, manager of the Stewart-Warner accessory division. They are: Auto Electric & Service Corporation, Detroit, Mich., E. A. Dunlap, Manager; Nippert Electric Products, Columbus, O., P. N. Nippert, Manager; Toledo Auto Electric Co., Toledo, O., G. Rubini, Manager. The new appointments are part of the expanded distribution program recently launched by the division.

Elastic Stop Nut Corp. Building New Plant

Elastic Stop Nut Corporation, Elizabeth, N. J., has recently broken ground for a new plant on Vauxhall Road, Union, N. J., a suburb of Newark. The plant will be used solely for the manufacture of the corporation's extensive line of self-locking nuts. It is laid out for the most efficient handling of materials and fabrication of the product, with provision for expansion as future needs may require. Transfer from the present plant will be made about June 1st. The Austin Co. of Cleveland, is the general contractor for the plant.

Joins Cummins Engine Co. Organization

Robert W. Stratton has recently been appointed to regional sales manager for Cummins Engine Co., Columbus, Ind. His territory covers an area north of the Ohio River, bounded by the State of Ohio and parts of Pennsylvania and New York. Headquarters are in Cleveland, O. Formerly a service manager and a district sales representative for a well known tractor and bulldozer manufacturer, Mr. Stratton brings valuable experience and information to his new duties. Norman E. Palmer, Indianapolis, Ind., another addition to Cummins Engine Co.'s organization, will be among the group which Dave Buttles, sales manager of Cummins Engine Co. will soon take to New York City to establish a factory sales office. Mr. Palmer's work as a factory sales representative will be supported by an unusually broad training. His five years' experience in the transportation department of an Indiana railroad was subsequent to an engineering degree at Purdue. This was followed by an intensive special 18-months study of the entire field of contractors' equipment with special emphasis on diesel engines. The new factory sales office in New York City where Mr. Palmer will have his headquarters will not be a part of the local sales and service office. It is felt that this new office will be available in establishing a closer relationship between the factory and its many eastern outlets.

J. B. Templeton Elected President of Templeton, Kenly & Co.

J. B. Templeton, formerly vice-president of Templeton, Kenly & Co., Chicago, manufacturers of Simplex jacks and equipment, was elected president of the organization at the annual meeting to succeed W. B. Templeton, who is now chairman of the board of directors. J. B. Templeton has been associated with the organization since 1928, at which time he started in the company's shops to literally learn the business from the ground up. Working in different phases of production, wherever an opportunity presented itself, Mr. Templeton eventually "graduated" to the clerical end of the business, taking with him a thorough groundwork. Subsequently, he entered the sales department working in various sections of the country, where he became familiar with the various problems of users of jacks in the oil fields, mines, construction projects, railroads, utilities and others. Mr. Templeton finally acceded to management of the New York office where he was in intimate contact with the export activities of his firm. In 1935, in order that W. B. Templeton, who founded the firm in 1899, might spend more time away from the plant building goodwill for the company's line of jacks in foreign countries and remote parts of the world, the younger Mr. Templeton assumed the duties of vice-president and sales manager.


J. B. Templeton

Harry B. Turner Celebrates 25 Years Service with P.C.A.

Every order for purchases made by the Portland Cement Association for the past 25 years has gone over the desk of Harry B. Turner, veteran purchasing agent, with the exception of one made recently. The exception was a silver coffee service, presented to Turner by the Association April 22, in appreciation of his 25 years of continuous service. On the anniversary date, Turner was called away from his desk and on his return found his department thronged with some 150 members of the Chicago general office staff, including Frank T. Sheets, President, who made the presentation. Turner came to the Portland Cement Association in 1915 when its headquarters was in Philadelphia and moved to Chicago when the general office was established there a year later. He has seen the scope of the association increase from a handful of men in the general office and one district office, to a staff of more than 450 people operating from coast-to-coast. President Sheets declared that Turner's record of service was a compliment to the association and pointed out that within the next few years several other members of the association staff will observe silver anniversaries.


Henry B. Turner

W. C. Swalley Made Assistant General Sales Manager of Wellman Engineering

W. C. Swalley, has been appointed assistant general sales manager of The Wellman Engineering Co., Cleveland, O. In addition to handling the sales of the "Williams" clam-shell and dragline buckets, as in the past, he assumes the broader duties of assisting in the sale of all Wellman engineered equipment.

Ted Craig Appointed General Sales Manager Trailer Co. of America

A. J. Woltering, Executive Vice President of Trailmobile, Cincinnati, announces the appointment of L. E. "Ted" Craig, as general sales manager of the Trailer Company of America, Cincinnati. An unusual background of experience in the mechanics of transport and its many problems qualifies Mr. Craig for this appointment. This truck transport experience dates from the early days of the New Way Motor Company, Olds, Reo, Federal, Sterling, and Packard. The latter concern loaned Ted to the U. S. Army in 1916 to lead the first Packard truck train sent into the interior of Mexico to find Pershing and establish a line of communication and supply for the Punitive Expedition.

W. A. Starck Joins Young Radiator Co. Organization

Mr. W. A. Starck, formerly engaged as consulting engineer of the Patent Works, Milwaukee, and previously chief engineer and factory manager of the well-known Badger Bumper Co., West Allis, Wis., has become associated in a factory management position with the Young Radiator Co., Racine, Wis. Mr. Starck brings to the company broad experience in engineering, designing matters pertaining to patent development and will give his special attention to manufacturing improvements, efficiency and product improvement.

Chain Belt Changes

Thomas E. Cocker has been appointed manager of the Detroit district office of Chain Belt Co. of Milwaukee. He succeeds Mr. G. A. Gunther. Mr. Cocker, who is a graduate of Rensselaer Polytechnic Institute, has been with the company since 1921 and has served as district manager of both the Cleveland and Buffalo offices. Mr. Klemme succeeds Mr. Cocker as manager of the Buffalo district office. Mr. Klemme has been with the company since 1935, serving in both the engineering and sales departments. He is a graduate of the University of Wisconsin. Mr. Robert Potter, a member of the home office sales organization at Milwaukee, has been transferred to the Pittsburgh office where he will assist Mr. Gayle Sherratt, district manager. Mr. Potter is a graduate of Carnegie Tech.

Well-Known Cleveland Rock Drill Man Dies

George H. Hall, secretary and sales manager of The Cleveland Rock Drill Co., Cleveland, O., and one of the founders of the concern, died at Lakeside Hospital, Cleveland, on March 7, 1940, of a lingering illness. In addition to his connection with The Cleveland Rock Drill Co., Mr. Hall was treasurer of the Cleveland Pneumatic Tool Co. of Canada, Ltd., and was a director of The Cleveland Hardware Co. Besides his widow, Elizabeth Adams Hall, Mr. Hall leaves four children, Charles A., William G., Jane (Mrs. Samuel Gunning), and Betty. He was a graduate of Case School of Applied Science, holding degrees of B.S. and M.E. He was a member of the University and Canterbury Country Clubs, of Cleveland. Mr. Hall's work in the Rock Drill concern will be handled by Russell R. Morgan, treasurer of the company, and for 15 years its assistant secretary and assistant sales manager.

Frank L. Edman Appointed Advertising Manager Reo Motors

Frank L. Edman has been appointed advertising manager of Reo Motors, Inc., Lansing, Mich. Mr. Edman was previously associated with Reo from 1934 to 1937. His extensive experience in automotive merchandising also includes executive positions with International-Harvester, General Motors, Federal Truck and Continental Motors. Mr. Edman's responsibilities will embrace all advertising, dealerization and sales promotion activities, which represent an important part in Reo's 1940 merchandising program.

Frank P. Blancett Made Sales Representative for Diamond Iron Works

Frank P. Blancett has been appointed sales representative for Diamond Iron Works, Inc., of Minneapolis, Minn., covering their dealer representation in stone, sand and gravel equipment for the states of Arizona, New Mexico, Texas, Oklahoma, Arkansas and Louisiana. Headquarters will be at the Clifton Hotel, Dallas, Tex. Mr. Blancett was formerly with the Austin-Western Road Machinery Co.

LeTourneau Makes Sales Changes

Wendell V. Richards, former Federal Sales Supervisor, has been promoted to Federal Representative in Washington, D. C., succeeding Stanley P. Means, who has taken over the position of Manager of the Sales Training Division with headquarters in Peoria, Illinois. George W. Lokey, Jr., Assistant Field Engineer, has filled the position of Federal Sales Supervisor vacated by Mr. Richards.

LeTourneau Factory in South Completed

The new subsidiary of R. G. LeTourneau, Inc. known as the LeTourneau Company of Georgia has recently completed its new, all-steel office and factory buildings in Toccoa, Ga. Both buildings are

of pressed steel panel, arc welded construction. The factory was built in equal sections which make a building 368 feet square with 135,424 sq. ft. of floor space. The office building is 115 by 161 ft. which gives 18,515 sq. ft. of floor space. The office building built entirely without windows is one of only five similar ones in the United States. The Toccoa building, however, differs from the others in that it is constructed completely of steel rather than the more conventional cement blocks or bricks. Modern, ideal, and controlled lighting is obtained by the use of shadowless Fluorescent lamps. In the summer time the building is completely air-conditioned, while in the winter, if the need should arise, it can be heated by a large centrally located oil burner with the heat circulated by pipes beneath the floor. All departments—drafting, production, accounting, personnel, purchasing, and executive—will be housed in this building. The factory was primarily built for the manufacture of a new LeTourneau product—the Tournapull. Located on a 2,000 acre tract, a few miles from Toccoa, this all-welded steel plant will practically double present LeTourneau manufacturing facilities. The sum of $725,000 was expended for plant machinery and equipment.

H. R. Murphy Appointed Sales Manager Central Division Caterpillar Tractor

Howard R. Murphy has been appointed sales manager of the central division for Caterpillar Tractor Co. He comes to "Caterpillar" from Sears Roebuck and Co., where he managed the tractor business for that concern. Mr. Murphy originally joined the "Caterpillar" organization thirteen years ago. Employed in various sales capacities, he became manager of the company's sales development division. In 1938, he left "Caterpillar" to take the post with Sears Roebuck. The central sales division comprises a large area in the middle west, extending north and south from the Great Lakes to the Gulf of Mexico. As sales manager, Mr. Murphy succeeds C. M. Burdette, who has resigned to take a brief rest and later to become associated in another business.

Charlie Spears Becomes Director of Sales Development, LaPlant-Choate

Charles A. Spears, widely known to construction men and roadbuilders, has resigned his position in the Caterpillar Tractor Co. sales department to become director of sales development for one of the company's allied manufacturers, the LaPlant-Choate Manufacturing Co., Inc., of Cedar Rapids, Ia. Mr. Spears has been identified with construction progress since modern earthmoving methods had their beginning. He is regarded not only as a foremost sales authority in this field, but in the sphere of construction engineering as well. After being graduated from the University of Southern California with the degree of civil engineer, Mr. Spears founded the Spears-Wells Machinery Co. of Stockton, Calif., in 1912, and became vice-president and general manager for this manufacturer of graders and oiling machinery. He left the firm in 1929 to become district representative of Caterpillar Tractor Co. in the California area, later serving as supervisor of government and construction sales. Of late he has been connected with the sales development division. Mr. Spears' services are acquired just as the LaPlant-Choate Co. completes its new 700x100-ft. factory addition, and obtains additional plant site suitable for further expansion adjoining the present property. The company now builds a complete line of hydraulic or cable-control carrying scrapers ranging from 2 to 35-yd. capacity. Its products also include trailbuilders, bulldozers and tampers. While he will make his headquarters at Cedar Rapids, Mr. Spears will spend considerable time in the field in cooperation with his company's district representatives.

H. O. Penn Machinery Co. Appointed Distributor for Bucyrus-Erie

The H. O. Penn Machinery Co., Inc., 140th St. and East River, New York City, has been appointed a distributor of Bucyrus-Erie ⅜ to 2½-yd. shovels, draglines, clamshells, and lifting cranes.

Personnel Changes in Davey Compressor Co.

The Davey Compressor Co., Inc., Kent, O., has announced the following additions to its executive personnel as of May 1, 1940: Russell Coles as Great Lakes district manager in charge of sales in Southern Michigan, Indiana, Kentucky, Tennessee, Western Pennsylvania and Western New York. An alumnus of Syracuse University, Mr. Coles comes from the sales department of the Mansfield Tire and Rubber Co., Mansfield, O. S. V. Saginor, as production manager and director of parts and service. A graduate engineer whose education was obtained at Case School of Applied Science, and Western Reserve University, Mr. Saginor was previously affiliated with Carbide and Carbon Chemical Co. of Charleston, W. Va.

NEW LITERATURE

Contractors' Equipment Cleaning Operations—"Contractors Performance Reports" is the title of a bulletin issued by the Magnus Chemical Co., Garwood, N. J. It contains a series of detailed performance reports from road and highway and other contractors, outlining improvements and economies effected by the use of properly selected cleaners for motors and chassis, bodies, machinery, radiators, sludge and gum control in motors, floors, etc., contrasted with previously used methods.

Melting Kettles—A new catalog, No. 658, illustrating and describing the improved "Speed-Master" melting kettle, has been issued by Hauck Manufacturing Co., 119-129 10th St., Brooklyn, N. Y. The catalog also covers a new combination skid and trailer kettle, barrel hoist, kettle thermometer, both hand and power spray attachments, as well as the "Speed-Master" gas fired kettle using petroleum gas in cylinders.

Bituminous Distributors—A new pictorial catalog has just been released by E. D. Etnyre & Co. of Oregon, Ill. Practically an "X-ray of the Black Topper," the new catalog pictures the world-wide distribution of Etnyre products, illustrates the three models which constitute the attractive 1940 line, then proceeds to show the "ins and outs" of the machines. Pictures and brief type matter take up feature by feature all the way from the spray bar to the cab controls and show why it is designed and built a certain way.

Gravel Plants—A new bulletin (No. 268-D) dealing with gravel plant layouts has been issued by the Smith Engineering Works, Milwaukee, Wis. It is an educational booklet for all gravel plant operators. The book is divided into several gravel plant layouts: Semi-portable sand and gravel plants; clay—hard to wash materials; dredge operations; 100% crushed gravel and regular gravel; commercial sand and gravel plants.

Hoist.—A bulletin (No. 100-H-O) featuring its new Model 20 American general purpose hoist has been issued by the American Hoist & Derrick Co., St. Paul, Minn. This hoist is furnished with gasoline power unit, or electric power (squirrel cage equipment and single line pull of 1000 to 2000 lb. Load and speed ratings and hoist specifications are included.

Concrete Mixers.—The Chain Belt Co., Milwaukee, Wis., has issued four catalogs for its 1940 line of Rex Concrete Mixers. Bulletin No. 360 describes the 1940 3½-S Mixer. The Rex 3½-S is a tilting mixer and the 1940 model has many new features. Bulletin No. 361 features the 1940 Rex 5-S and 7-S Mixers. These machines are made in either two or four wheel, end or side discharge models with light or heavy duty engines. The 1940 Rex 10-S and 14-S mixers are described in Bulletin No. 362. These machines have all the features that are found on the Rex 5-S and 7-S Mixers plus many additional refinements. Now in this book is the 14-S two-wheel trailer model mixer. "Rex Big Mixers for Modern Mixing Plants" is the title of Bulletin No. 363. Rex 28-S and 56-S mixers are described in this book.

Timber Bridge Designs—A bulletin on the use of timber connectors in the construction of highway bridges—"Modern Timber Highway Bridges"—has just been issued by the Timber Engineering Co., 1337 Connecticut Ave., Washington, D. C. Containing twelve typical selected highway bridge designs, the result of a bridge design contest conducted by the company last year, the booklet points out the advantages and economy of timber bridges built with the connector system of construction. Structures with spans from 30 ft. to 70 ft., designed for either H-10, H-15, or H-20 loadings are illustrated.

Tractor Shovels—The Frank G. Hough Co., Libertyville, Ill., has issued a new pictorial bulletin, "Shortest Route to Lower Operating Costs," depicting Hough tractor shovels on road building, excavating, stock piling, leveling, backfilling, slushing and clean-up work. Also shown are Hough tractor and truck towed sweepers, combination sweeper-blowers and tractor mounted sweeper-blowers.